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THE AUTOMOBILE

FREIGHT automobiles are now the vogue in the transportation of merchandise. The time has arrived when the merchant who disregards this fact is bound to fall by the wayside. The freight automobiles that will be placed upon exhibition at the Garden in New York City during the second week of the A. L. A. M. show are not to be regarded as stylish ahead of utility, or interesting for any other reason than that which has sturdy commercial value as an abiding faith. This is not the time to talk of compromises; of how a passenger chassis, with all its pleasant lines, will improvise; the 1911 freight automobile show, at the Garden, will be made up of real, serious freight automobiles. They are being made for this specific purpose, and that they will do the work for which they are being made is proven by the fact that they are doing the work now.

It will be a great misfortune, a calamity, but it will be the affair of the merchant who is blind—stone-blind mentally—if the attendance during the freight automobile week at the Garden is one of "sight seeing" on the part of the morbid and the curious. The lineup,

let us predict, a long and a strong one, will be of the merchants of New York City and of every other city for miles around—they can ill afford to delegate a representative—he might be mentally blind—as blind as a bat.

Let the merchant, the man who must, in the long run, pay the score, come to the Garden; bring along a staff of trained and trusted assistants, but come personally! Look at the freight automobiles that are being made at the present time to supply a real demand. Stand off, fancy free; take a good "intelligent" look; get a fair perspective; observe that the makers of freight automobiles are alive to the needs, and that these needs are being supplied right now.

The Elephant Never Discovered That He Was Free

The man who goes on trying to be some one despite that his effort is no faster than the oxen that are relied upon to draw his wagon is like the merchant who listens to the clatter of the shoes of the horses that he pays good money for to keep him from maintaining a desirable position in the procession, but no different from the elephant that was tied to a post so long that when he was untied he did not know the difference. He hung around the post and looked "green-eyed" at the more progressive elephants who partook of the refreshments that are available at every hand for the elephant who knows that he is foot-free.

Be an elephant, size considered, but a free elephant. Don't imitate the poor, forlorn pachyderm who was tied to the post for so long a time that he lost sight of the fact that there is such a thing as the future; that advances are made, and that the time comes when it is proper to unshackle the limbs and allow freedom of action. But will this limb-freedom bring thought-freedom; will the elephant know that he is no longer tied to the post? Does the average merchant know that he is now in a position to make material headway?

Standing on the brink of his own commercial grave, the man who pays seven hundred dollars per span for animals that will have to compete with machines in the transportation of merchandise asks the question: are automobiles now reliable? This man of questioning propensity straightaway turns to his confidential clerk and says: draw a check for $3,500 to pay for the horses that we purchased to replace the dead ones of a month! Let there be no quibble about the amount; let it be taken for granted that horses die sooner than the breath of life departs from steel, but oh! let there be no more foolish comparisons of apples, and of oranges; of horses, and of steel.

It is more than likely that the readers of THE AUTOMOBILE will expect to have placed before them a long list of statistics, giving comparisons of cost between animal and automobile transportation of goods; they will probably say: THE AUTOMOBILE does not devote a large amount of space to this sort of a thing as a rule, but now that there is to be a freight automobile exhibition the editor will awaken to the fact that there is such a thing as comparison; adding applies to oranges, no doubt!

But there will be no such license taken with the facts, the cold, hard facts, in THE AUTOMOBILE, at any rate. There is just as much reason for desiring to compare the ability of a "prairie schooner" with a modern freight train as there is in comparing animal transportation with automobile methods. It cannot be done; the attempt will not be made; the merchant who desires to fall by the wayside is advised not to apply any of his effort to the understanding of the plight of the poor elephant who forgot that he was free to follow the bent of his own inclination, but the trouble with him was that his mind was petrified.

There is such a thing as a stone brain; a petrified mind; a condition of coma; this condition does not have to be the result of a century of slow chemical action; Nature is a most versatile organism; she finds many ways of bringing about the state called petrification; one way is represented in the process by which a situation is continued by force of habit.

Force of Habit Is the Friend of Failure

Let it not be supposed that any time is being wasted here for the purpose of trying to induce any merchant to place any reliance at all upon a "half-baked" imitation of a freight automobile such as through force of habit the average merchant has turned down every year for a decade. There is such a thing as an imitation of a good freight automobile, just as there is the horse that is not worth trying for any commercial purpose. But why is it that a merchant will allow himself to make poor comparisons? How comes it that this habit grew? What is the nature of the substance that holds the mind in subjection?

Perhaps the greatest influence against freight automobiles lies in the experience that nearly every merchant has with passenger automobiles. It takes a merchant to make a failure of everything that he does not understand; the fact that he is a success as a merchant is enough to make him a failure as an automobilist. If the trouble lies in the desire to do things on a large scale, and in this desire, in the absence of a little knowledge of the attending facts, a large, powerful automobile is selected, and after it is driven at high speed for a month or two the merchant is able to testify to the size of the tire bill and to the fact that "freight automobiles" belong in the same class, but is this testimony worth anything? Probably not!

The Law and the Freight Automobile

Too much speed is bound to wreck any kind of a machine. A flywheel attached to the crankshaft of a steam engine, if it is rotated more than a mile in a minute, counting the rim speed, will be regarded as a bad insurance risk, and every insurance appraiser knows that the danger increases as the velocity squared. In the same way let it be understood that the merchant gathers the idea that automobiles are expensive. How does he arrive at this conclusion? How, to be sure? By racing around the country in a big limousine at high speed, violating the speed laws and the laws of materials as well. The life of the automobile is proportional to the square of the velocity and to the weight. But the man who is so well grounded in the disposal of merchandise is not likely to have much time to appreciate the fact that weight, *per se*, is not so disconcerting; that it is speed, *per se*, that gets at and attacks the vitals of the automobile. But it is also necessary to figure in weight in determining the effect of speed upon the life of a car.

As a general proposition, the makers of automobiles complain of the attitude of purchasers. They seem to want racing automobiles in which to put freight in order that they can race it to the dock or the freight depot of the nearby railroad. Just what this racing means is best shown by this tabulation:

RELATIVE LIFE OF A ONE-TON AUTOMOBILE AT DIFFERENT SPEEDS

Speed in miles per hour	Relative life of the automobile
5	14.4 years
6	10 years
7	7.6 years
8	5.8 years
9	4.58 years
10	3.6 years
11	3 years
12	2.5 years

NOTE:—In approximating the relative life of automobiles under a given condition of loading, as influenced by speed, it is not the purpose here to say that any given make of automobile is to be substituted in place of the theoretical automobile which is taken in the example. It is enough here to show that the life of an automobile of a given weight will depreciate in proportion as the square of the velocity, and it is to the interest of the merchant who elects to employ automobiles to see that they are not required to run at a speed any higher than that which is absolutely necessary to accomplish the intended work.

RELATIVE LIFE OF AUTOMOBILES WHEN THE WEIGHT VARIES

Weight of a speed of six miles per hour	Relative life in years
1,500 pounds	13.33 years
2,000 pounds (rated loading)	10 years
3,000 pounds (.50 per cent. over-load)	4 years

NOTE:—The above tabulation shows that over-loading is sure to sap the life of an automobile, and that it is far better to limit the load to less than that which is likely to figure out on a basis of a 10 per cent. depreciation.

This brings us face to face with one of the great troubles that makers of freight automobiles have to contend with. The size of the platform, considering the character of the merchandise that is to be transported, settles upon the amount of the load that the automobile will have to support. It is useless to say that a car is of a certain capacity; that it is unsafe to exceed a certain loading. The man who is engaged to run the automobile will surely put all that he can upon the platform, and he will exercise a certain amount of ingenuity in the process. To the driver of the freight automobile there is one way to determine how much the automobile is capable of carrying; that is, all that it will carry for one trip. If the automobile is distressed by the load it is not the driver who will groan; he will complain a little if he has to use the low gear, but it will never occur to him that the life of the automobile is being sapped.

The merchant who desires to make a success of the freight automobile under the circumstances must certainly make sure that the platform will not be large enough, considering the character of the goods that he desires to transport, to overload the automobile, and it is then enough of a problem to adequately determine all of the attending facts. There are too many merchants now awaiting the coming of the cheap freight automobile, but it is gratifying to note also that there are quite a few of the more wise merchants who are awaiting the advent of the high-priced freight automobile.

When a man goes in quest of a freight automobile the first question that he should ask is: do you charge enough for your make of car? Can you afford to build a good automobile at the price that you are asking? Does your make of automobile travel slow enough? Would it not be better to place a lower limit upon the speed? Do you not know that it is foolish to race a heavily loaded automobile for five blocks for no better purpose than to wait in line for two hours? Why hurry at the wrong end of the line? I see that your chassis is highly polished. Who has to pay for the polish? What utility purpose does it serve? Is it not a fact that an automobile axle is stronger if the skin is left on the forging than if it is milled off? The color of the varnish is as good as that which adorns my $5,000 limousine! What is the utility purpose? Is the steel under the "color" up to a proper standard? Are there any welds concealed by an elegant coat of finish? Do you know that the twisting moment is greater in slow-moving machinery than it is in high-speed machinery? If so, is it not a fact that you should not try to convert a touring automobile, which is designed for high speed and low torque, into a freight automobile, where the reverse is true?

What Strange Ideas Creep Into a New Art

As a rule, not occasionally, merchants say: "I much desire that my wagonmaster shall have charge of the new freight automobiles that I am about to purchase, and I also expect to keep my old drivers." Good wagonmaster! Excellent drivers! Know all about horses! Go ahead, Mr. Merchant; it is a shame to discourage philanthropy; there is not enough of it in the world. While you are about it, place your office boy in charge of the treasurer's funds; place the janitor in the general manager's chair; put a floor-walker down in the engine room, and displace the purchasing agent in favor of the new clerk.

But, after all, what does the wagon-master know about freight automobiles? Where would he get the information? How would he tell what to do to properly maintain the machinery? What knowledge has he of the fact that a "dry" bearing might cost enough to pay his salary for a whole month?

What would it matter to him if the cylinders suffered through want of lubricating oil or if a leaky radiator was allowed to go unchecked, when a short stoppage would suffice to tighten up a gasket, and so prevent overheating?

Is it not the very class of driver who is so proficient at handling horses who has done more damage to the automobile situation than can be fixed in a decade? What would such a driver think of overloading an automobile? Take the man who would kick a horse in the belly for no cause, how would he do to run an automobile? What part of it would he select as most susceptible to his brutality?

Some of the Considerations for Economy

In economy runs it invariably happens that some automobile that is not noted for speed, although it is usually a good hill climber, takes the prize. Why is this? Does it not show that speed is not the criterion? Is it not true that economy is coupled with "ton-miles" rather than with "miles per hour"?

In every economy run involving the use of passenger automobiles the men who have charge of the cars load them down as heavily as possible, and drive at a slow, steady gait. They always win. The reason is obvious. The contest rules are invariably framed to exclude freight automobiles. The reason is that no passenger automobile, no matter how well made, would have the slightest chance of winning against a heavy, slow-moving freight automobile.

If it is true that weight and low speed lead to economy of performance, it follows that in the selection of freight automobiles the same rule holds, and it is far from wise to demand speed, lightness and other "refinements" the character of which lead diametrically opposite to the result sought after.

In a "two-gallon test" which was competed for a couple of years ago, despite the presence of a considerable number of high-priced, well-made passenger automobiles, a gasoline truck took the prize. This was no sign of lack of good qualities in the passenger automobiles; they were never designed for economical work as measured in ton-miles; they were made for economical work as measured in miles per hour. But the truck, despite the fact that it was just an ordinary gasoline affair; one that went along under a heavy load, making relatively slow speed; it allowed no room for argument, and it showed the committee the futility of trying to compete with heavy, slow-going trucks, so far as passenger automobiles are concerned.

What Tests Show for Fuel Economy

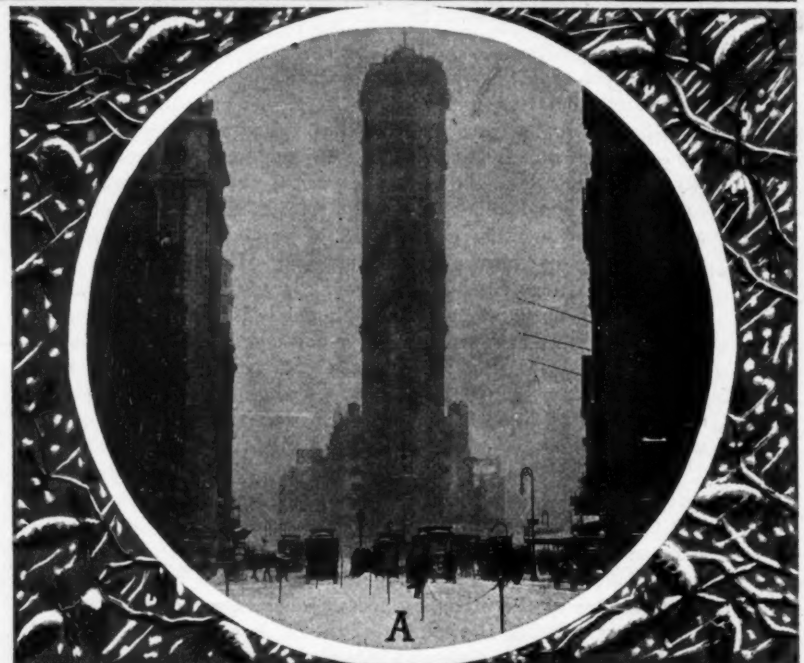
Considering freight automobiles only, taking into account the gross weight, also the tare, then the gasoline and lubricating oil consumption and speed, the following is a record of actual realizations:

RECORDS OF PERFORMANCE OF FREIGHT AUTOMOBILES UNDER TEST

Total weight in pounds	Useful load in pounds	Average speed in miles per hour	Miles per gallon of gasoline	Miles per gallon of lubricating oil	Test record number
12,658	5,796	14.6	9.4	368	1
14,524	7,896	11.0	11.1	194	2
13,299	8,427	9.5	11.3	254	3
13,161	7,444	9.5	10.3	320	4
13,106	7,903	10.4	10.3	178	5
13,346	8,143	10.4	10.1	178	6
13,855	8,593	8.9	8.6	209	7
13,822	8,553	8.6	8.2	178	8
12,323	7,609	9.6	11.2	145	9
10,832	6,710	9.8	12.1	163	10

Depicting the Practicability

THE recent cold snap has done more than anything else to demonstrate to buyers and public alike the superiority of the mechanically propelled vehicle over its predecessor. The word rival would be too strong to be used as a comparison, as it is admitted on all sides that the motor truck and taxi are impervious to all weathers. The fleet taxi, equipped with chains over the tires, can grip the snow with security, which is the main factor, and this, combined with the present-day reliability of the vehicles themselves, makes it possible to keep appointments in all weathers. A glance at Figs. E and D shows how the operator of the gasoline truck is sheltered from the inclemency of the pelting snow while the driver of the two-horse wagon is entirely exposed. The limit of physical endurance will soon knock the latter under, and provided the former is well clad he is not exposed to severe hardships. The operator is as important almost as the means of transportation, for unless he can control his charge in a competent manner efficient service cannot be expected. The illustrations of the street scenes here depicted were taken in the streets of New York during the recent snowy weather and are convincing to any one that loves animals that they are altogether incapable of rendering efficient service under adverse weather conditions. The ills and troubles of the horse are too well known to be recapitulated, but to some the wants of the motor-propelled vehicle, although few, should be carefully gone into and provision taken against eventual possibilities of disorder. The first is to see the operator properly clad and provided with some shield for protection. This can be made collapsible, with a small vision hole, detached when not in use and stored carefully. Non-skids of some description should be fitted to at least one of the driving wheels, but to prevent the slipping that is liable to take place at starting two would be better. If the truck has to make stoppages of any length of time an anti-freezing solution would be desirable in the water circulation, and during such waits a good cover over the radiator. The lubrication should not be left entirely to the operator, but some competent person should be consulted as to any change that might be considered necessary in the thickness of the lubricant and its level in the engine. Such precautions are not troublesome and when once at-



A

C

E

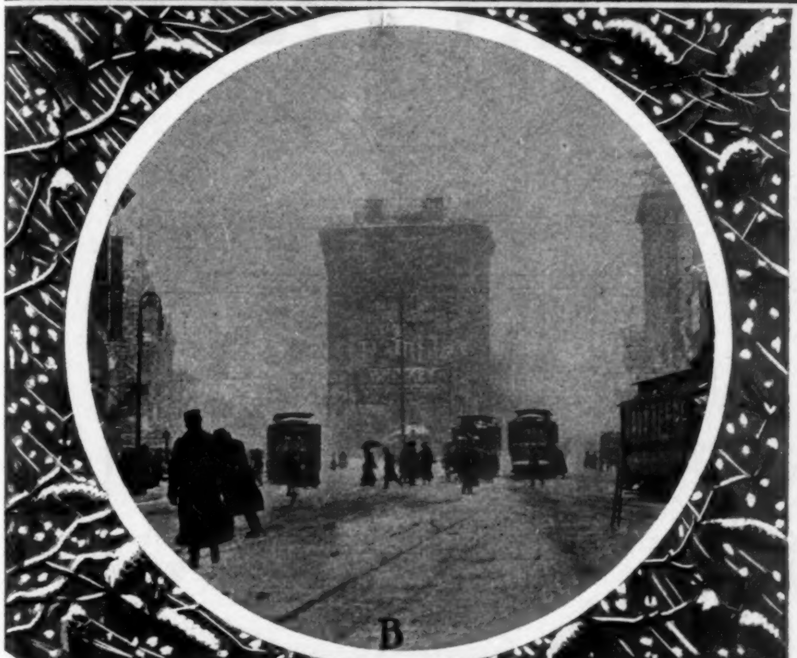
F

of the Freight Automobile

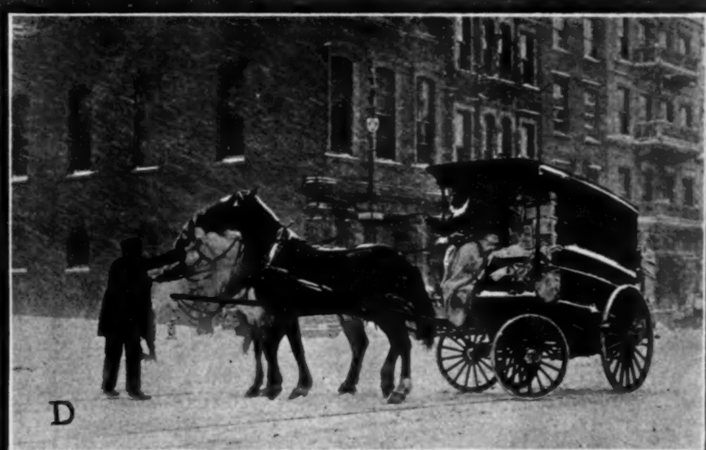
tended require no further attention. Fig. A shows what is ordinarily a busy spot looking from Forty-fifth street toward the Times Building, and the one solitary horse-drawn wagon is indicative of the trouble encountered in transportation at times like these. Then again the extra expense entailed in having to employ extra horses to draw a load ordinarily the capacity of two as seen in Fig. F has to be taken into consideration when it comes to a question of dollars and cents. It is still well within the recollection of all when after a fall of snow the express and other services were so disorganized that traffic bordered on the chaos that reigned during the recent express strike; but to-day, thanks to the motor, such things cannot happen.

The two methods are clearly depicted in Fig. C. A motor truck will be seen going on its way rejoicing, while the empty wagon and the quadruped have the greatest difficulty in getting along at all. Another point not always taken into consideration in reviewing the situation is the great mortality that prevails among horses due to the cold and the effects of falls. The worst that can happen to the new creation is a skid, which can be guarded against, but when the friend of man lays in an inanimate state, and it may be one that has hardly started his career as a beast of burden, then the loss is most felt by the unfortunate owner. A damaged automobile can be repaired for a small amount compared with the initial cost, and if the depreciation has been carefully figured out as to the costs of the two means of traction—and such a calamity could happen that the horse dies prematurely—then the calculations are likely to be upset.

Those who have wintered in Switzerland know from practical experience that the "diligence" is never to be relied upon in the Winter months, but over several of the passes that have a motor-passenger and postal service the snow must be over the height of the wheels for the service to be held up, and in such cases as this it is no uncommon sight to see a motor plough starting out and clearing the way for other traffic. Unless the snow is over a foot deep there should be no difficulty in maintaining the same average speed with a motor truck as on a dry road, as the weight is usually sufficient to allow the wheel to plough through and grip the surface of the road.



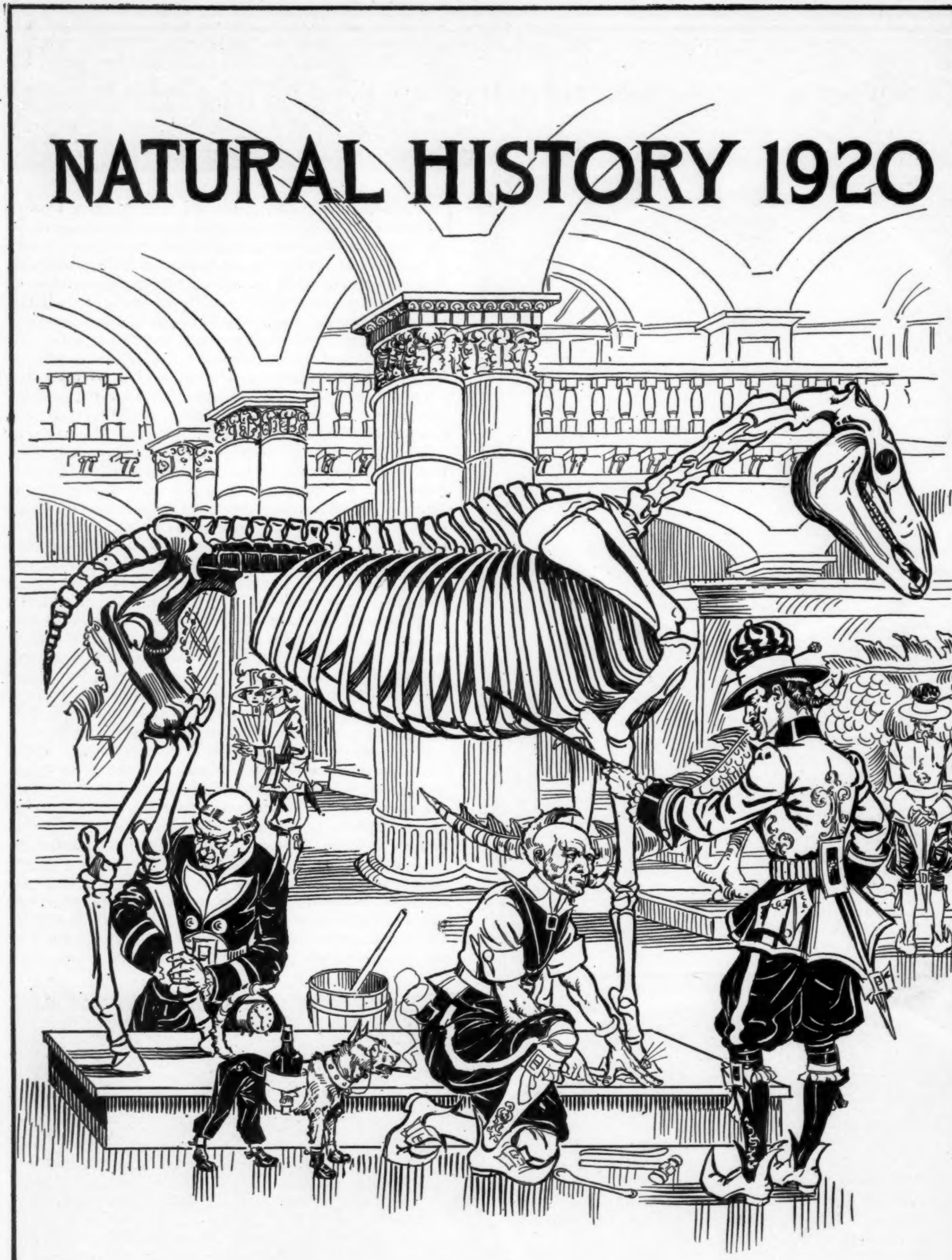
B



D

G

H


NATURAL HISTORY 1920

Foolproofing Truck Mechanism

PROGRESS MADE IN PROTECTING MOTORS AND MACHINERY FROM THE EFFECTS OF IDLE TAMPERING DESCRIBED BY A. J. SLADE, MEMBER OF THE S. A. E.

IN connection with both electric and gasoline machines, the question of overloading is always a serious one, and as yet no automatic means of preventing this has been devised. Some experiments have been made in the direction of producing an indicator to show the approximate load, by measuring the deflection of the springs.

Another prolific cause of trouble, especially in gasoline trucks, is overspeeding. The most practical means of obviating this is by the use of a centrifugal governor operated from some rotating part, such as cam or other shaft, which revolves at a speed proportional to the speed of the motor. Such a governor, by being connected to a valve at some point between the carbureter and the intake manifold, can be adjusted so as to give a reasonable regulation of the motor speed and thereby prevent the racing of the motor and the excessive speeding of the truck.

A simplification in the motor control can be accomplished by the elimination of the spark advance and retard lever, thereby controlling the motor speed by the throttle lever alone. Two well-known makes of magnetos are manufactured to meet this requirement, one having a centrifugal controller which automatically advances or retards the spark by rotating the armature out of its normal position.

Oiling systems are open to improvement in the direction of eliminating the adjustment of sight or other feeds, but it is desirable for the driver to have means of knowing that the motor is always securing proper lubrication when running and at the present time the constant level splash system with adjustable sight feeds, maintaining practically uniform oil level in crank case, seems to involve the minimum of complication. Many of the members of the society doubtless have been working on this lubrication problem.

The lubrication of spring shackles, wheel bearings, steering gears, clutches and other parts is obviously of the utmost importance in order to minimize wear, but no device has yet appeared which accomplishes this automatically. Compression grease cups placed at points sufficiently accessible to encourage the operator to use them give the most satisfactory results.

Clutches have apparently narrowed down to practically two types, the disc and the cone. The disc clutch necessarily has a far greater number of parts, runs entirely encased, and while having the advantage of being easily slipped during acceleration, is not so readily inspected or so conveniently repaired as the cone clutch, which is in all probability the simplest known type and which, being in full view, can be easily understood by the least intelligent driver.

The type of transmission is also a question open to discussion, and it is not likely that any real standardization will be effected in the near future. The sliding gear is in more general use than any other one type. The selective type with gear shift locking device and gears of large diameter and wide face presents no serious difficulties to the average driver, and when suitable materials, properly heat treated, are used in the gears, there is little likelihood of damage due to careless gear shifting. But where it is certain that the drivers will be of a low order of intelligence, other types of transmissions are at least worthy of consideration. The best known of these types is the planetary, which, owing to the principle of its construction, is limited to only two speeds having an approximate ratio of 3 to 1. This wide variation of speed necessitates the introduction of some means of permitting acceleration. In the case of one make of truck at least it has been necessary to introduce in addition to the usual planetary transmission clutch a set of friction discs. The contracting bands also require frequent adjustment for wear and periodical renewals of wearing surfaces. The advantage of doing away with the sliding of gears, is, in the minds of many, more than offset by the limitation in number of speeds in the planetary type of transmission. It is a type more especially suited to light-weight vehicles where the question of acceleration is not so serious as in heavy trucks, and in service where the least skillful drivers are employed, although one well-known truck uses this transmission for loads up to ten tons. Friction drives, doing away with both clutch and speed gears, doubtless have points of merit, but there is a practical limitation in the amount of power possible to transmit satisfactorily by this system, and it is questionable whether this device can be successfully used in any but the lighter capacity machines. Modifications of the sliding gear transmission are used to some extent, the best known being of the jaw clutch type, with gears always in mesh; the speed changing being accomplished by sliding the jaw clutches.

Freight Vehicles of 1911

MARVELOUS ADVANCEMENT IN THIS BRANCH OF THE AMERICAN AUTOMOBILE IS SHOWN BY THE BIG TRUCK LIST TABULATED HEREWITH

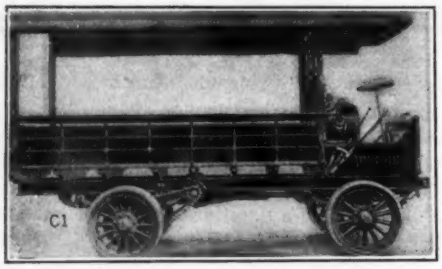
NOTHING can give a better idea of the high level of excellence and utility to which the American-made motor truck has advanced than an examination of the following tables. Over one hundred makes of gasoline cars are detailed, ranging in power and price from the least to the greatest.

There are also about a dozen electric truck manufacturers whose product is partially set forth in the tables.

The cars mentioned are not necessarily those alone which showed at the recent Palace exhibition or those scheduled for space at the Garden next week. They include all the leading makes of cars manufactured in the United States, whether they show in New York or not. About two dozen were exhibited at the Palace and over three dozen will be shown in the Garden. Many of those not displayed at either place possess numerous points of excellence.

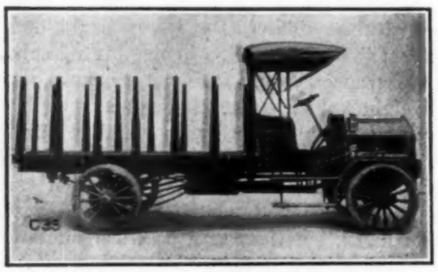
The utmost care has been used in gathering the material so that its presentation may mean something to the person interested in the subject.

Details of Freight Automobiles

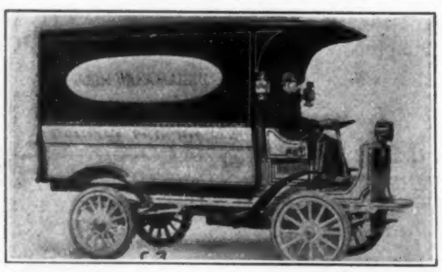


Alco 3-ton platform truck

Atlas Delivery Wagon, capacity 1,500 pounds



Atterbury Model L 30 1 1-2-ton stake truck



Autocar delivery wagon, Type XXI

Brush light delivery car

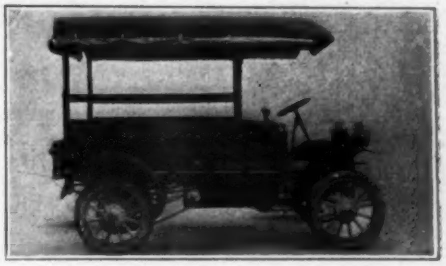
MAKES AND MODELS	Price	H.P.	BODY	MOTOR				COOLING		IGNITION		Lubrication	Clutch
			Type	Cyl.	Bore	Stroke	How designed	Radiator	Pump	Magneto	Battery		
A.B.C. "PO"	$525	14.5	Open	2	4½	4	Single	Air coold	None	......	......	F. feed	M. Disc
A.B.C. "FO"	850	14.5	Delivey	2	4½	4	Single	Tubular	Syph'n	......	......	F. feed	None
A.B.C. "FO-4"	1050	25.0	Deliv'y	4	4	4	Pairs	Tubular	Cent 'fl	......	......	F. feed	None
Acorn	.....	20.0	Lt Del.	2	5	4	Single	Tubular	Syph'n	H. T.	......	F. feed	None
Adams A	2400	22.5	Optionl	4	3¾	5	Block	Tubular	Cent 'fl	H. T.	......	F. feed	Cone
Adams B	1600	12.0	Optionl	2	3¾	5	Block	Tubular	Cent 'fl	H. T.	......	F. feed	Cone
Alco	3400	24.0	Opt'nal	4	3¾	4¾	Pairs	Cellular	Cent 'fl	H. T.	......	Splash	M. Disc
American B	.....	38.0	Stake	4	4¼	5½	Pairs	H'comb.	Cent 'fl	H. T.	Storage	Splash	Cone
American M	3000	38.0	Exp	4	4¼	5½	Pairs	H'comb	Cent 'fl	H. T.	Storage	Splash	Cone
American L	3750	38.0	Stake	4	4¼	5½	Pairs	Tubular	Cent 'fl	H. T.	Storage	Splash	Cone
American O	4500	44.1	Stake	4	5½	6	Pairs	Tubular	Cent 'fl	H. T.	Storage	Splash	Cone
American Eagle	.....	25.6	Deliv'y	4	4	5	Pairs	Tubular	Syph'n	H. T.	......	F. feed	Cone
American Stand.	1400	20.0	Optionl	2	5	5	Single	Tubular	Cent 'fl	H. T.	Dry	Pump	Friction
American Stand.	1900	24.0	Optionl	2	5¼	5½	Single	Tubular	Cent 'fl	H. T.	Dry	Pump	Friction
American Stand.	2700	32.0	Optionl	4	4¼	4	Single	Tubular	Cent 'fl	H. T.	Dry	Pump	Friction
American Stand.	3500	48.0	Optionl	4	5¼	5¼	Single	Tubular	Cent 'fl	H. T.	Dry	Pump	Friction
Atlas L	2000	16.2	Expr.	2	4½	4½	Integ.	Tubular	Cent 'fl	H. T.	Dry	F. feed	M. Disc
Atlas K	2400	16.2	Taxicab	2	4½	4½	Integ.	Tubular	Cent 'fl	H. T.	Dry	F. feed	M. Disc
Atterbury K-20	1600	22.0	Optionl	4	3¾	4½	Single	Tubular	Cent 'fl	H. T.	Dry	Splash	Cone
Atterbury L-30	2500	28.0	Optionl	4	4½	4½	Pairs	Tubular	Cent 'fl	H. T.	Dry	Splash	Cone
Atterbury M-50	3500	38.0	Optionl	4	4½	5½	Pairs	Tubular	Cent 'fl	H. T.	Dry	Splash	M. Disc
Atterbury O-60	4500	57.0	Optionl	6	4½	5¼	Pairs	Tubular	Cent 'fl	H. T.	Dry	Splash	M. Disc
Autocar XXI	2150	18.0	O. &Cl	2	4½	4½	Pairs	Tubular	Cent 'fl	H. T.	Dry	F. feed	M. Disc
Avery Tractor	3000	36.1	Platfm.	4	4¾	5	Single	H'comb.	......	H. T.	......	Splash	Plate
Beck	2000	24.2	Truck	2	5½	5	......	H'comb.	Cent 'fl	H. T.	......	F. feed	Band
Beyster Detroit	1250	19.6	Closed	4	3½	5	Block	H'comb.	Syph'n	H. T.	Dry	Splash	M. Disc
Blacker	650	12.8	Lt. Del.	2	4	4	Single	Tubular	......	......	......	Splash	Band
Blacker	2250	27.2	Optionl	4	4¼	5½	Pairs	H'comb.	Cent 'fl	H. T.	......	Splash	Band
Blacker	3300	40.0	Optionl	4	5	5	Pairs	Mercedes	......	H. T.	Dry	Splash	M. Disc
Brodesser F-3	3250	32.4	Any	4	4½	5½	Vert.	Cellular	Cent 'fl	H. T.	Dry	Sf. con.	Cone
Brodesser E-2	2750	28.9	Any	4	4½	5	Vert.	Cellular	Cent 'fl	H. T.	Dry	Sf. con.	Cone
Brodesser D-15	1850	28.9	Any	4	4½	5	Vert.	Cellular	Cent 'fl	H. T.	Dry	Sf. con.	None
Brodesser B	1450	28.9	Deliv'y	4	4½	4	Horiz.	Cellular	None	H. T.	Dry	F. feed	None
Brush	685	9.6	Enclos.	1	4	5	Vertic.	H'comb.	None	H. T.	Dry	Splash	M. Disc
Buick	1000	16.2	Optionl	2	4½	5	Pairs	Tubular	Gear	H. T.	Dry	F. feed	Cone
Buick	1200	16.2	Closed	2	4½	5	Pairs	Tubular	Gear	H. T.	Dry	F. feed	Cone
C and B	.....	36.1	Optionl	4	4¾	5	Pairs	H'comb.	......	H. T.	......	Splash	M. Disc
Carlson	3500	32.4	Optionl	4	4½	4¾	Pairs	Cellular	......	H. T.	......	Pump	M. Disc
Carlson	2750	19.6	Optionl	4	3½	4	Block	Cellular	......	H. T.	......	Pump	M. Disc
Cass D	1950	25.6	Optionl	4	4	4½	Block	Tubular	Syph'n	H. T.	Dry	Splash	Cone
Champion	2500	28.9	Pltform	4	4½	5	Pairs	Tubular	Cent 'fl	......	......	F. feed	M. Disc
Champion	3000	36.1	Platfm.	4	4¾	5½	Pairs	Tubular	Cent 'fl	H. T.	......	F. feed	M. Disc
Chase D	900	16.8	Exp	3	3¾	4	Single	Air coold	None	H. T.	None	Splash	M. Disc
Chase D	1050	16.8	Deliv'y	3	3¾	4	Single	Air coold	None	H. T.	None	Splash	M. Disc
Chase H	1250	20.0	Exp	3	4¼	4	Single	Air coold	None	H. T.	None	Splash	M. Disc
Chase H	1300	20.0	Stake	3	4¼	4	Single	Air coold	None	H. T.	None	Splash	M. Disc
Chase J	1800	24.3	Stake	3	4½	5	Single	Air coold	None	H. T.	None	Splash	Cone
Cino	2000	30.6	Closed	4	4¾	5	Pairs	Tubular	Cent 'fl	H. T.	Dry	Pump	M. Disc
Clark	.....	20.0	Expres.	2	5	5½	......	Tubular	Syph'n	H. T.	......	F. feed	Cone
Clark	1750	22.5	Optionl	4	3¾	5	Block	Tubular	Syph'n	H. T.	......	F. feed	M. Disc
Coleman 91	1150	....	Truck	2	4½	5	Single	None	None	H. T.	Dry	Splash	M. Disc
Coleman 92	1250	....	Deliv'y	2	4½	5	Single	None	None	H. T.	Dry	Mech.	M. Disc
Commer Car	5000	25.6	Optionl	4	4	4¾	Pairs	Tubular	Syph'n	H. T.	......	P. & G.	Cone
Commer Car	5500	30.0	Optionl	4	4¼	5.51	Pairs	Tubular	Syph'n	H. T.	......	P. & G.	Cone
Commer Car	6500	38.0	Optionl	4	4¾	5.51	Pairs	Tubular	Syph'n	H. T.	......	P. & G	Cone
Commer Car	6500	38.0	Optionl	4	4¾	5.51	Pairs	Tubular	Syph'n	H. T.	......	P. & G.	Cone
Cortland	1050	14.5	Deliv'y	2	4½	4½	Single	Air coold	Syph'n	H. T.	Dry	Mech.	M. Disc
Cortland	1100	14.5	Deliv'y	2	4½	4½	Single	Tubular	Syph'n	H. T.	Dry	Mech.	M. Disc
Cortland D-2	1325	14.5	Panel	2	4½	4½	Single	Air coold	Syph'n	H. T.	Dry	Mech.	M. Disc
Cortland D-2	1375	14.5	Panel	2	4½	4½	Single	Tubular	Syph'n	H. T.	Dry	Mech.	M. Disc
Cortland B-1	1225	14.5	Exp	2	4½	4½	Single	Air coold	Syph'n	H. T.	Dry	Mech.	M. Disc
Cortland B-1	1275	14.5	Exp	2	4½	4½	Single	Tubular	Syph'n	H. T.	Dry	Mech.	M. Disc
Cortland A-1	1100	14.5	Bus	2	4½	4½	Single	Air coold	Syph'n	H. T.	Dry	Mech.	M. Disc
Cortland A-1	1150	14.5	Bus	2	4½	4½	Single	Tubular	Syph'n	H. T.	Dry	Mech.	M. Disc
Courier	3000	28.9	Optionl	4	4½	5	Block	Cellular	Cent 'fl	H. T.	None	Pump	M. Disc
Courier	2000	22.5	Optionl	4	3¾	5	Block	Cellular	Cent 'fl	H. T.	None	F. feed	M. Disc

A. B. C.—A. B. C. Motor Vehicle Mfg. Co., St. Louis, Mo.
ACORN—Acorn Motor Car Co., Cincinnati, O.
ADAMS—Adams Bros. Co., Findlay, O.
ALCO—American Locomotive Co., Providence, R. I.
AMERICAN—American Motor Truck Co., Lockport, N. Y.
AMERICAN EAGLE—American Eagle Motor Car Co., New York.
AMERICAN STANDARD—Am. M. T. Co. of Mich., Detroit, Mich.
ATLAS—Atlas Motor Car Co., Springfield, Mass.
ATTERBURY—Atterbury Motor Car Co., Buffalo, N. Y.
AUTOCAR—Autocar Co., Ardmore, Pa.
AVERY TRACTOR—Avery Co., Peoria, Ill.
BECK—Beck & Son, Cedar Rapids, Ia.
BEYSTER-DETROIT—Beyster-Detroit Mot. Car Co., Detroit, Mich.
BLACKER—John H. Blacker Co., Chillicothe, O.
BRODESSER—Brodesser Motor Truck Co., Milwaukee, Wis.

on the American Market for 1911

TRANSMISSION							BEARINGS			WEIGHT		TIRES	
Type	Speeds	Location	Drive	Wheelbase	Tread	Frame	Crankshaft	Transmission	Axle	Of Car	Carry. Cap.	Front	Rear
Plane....	2	....	Chain...	80	56	P. Steel.	Plain...	Plain..	Roller...	900	....	28x2½	28x2½
Friction.	2	Motor..	2 Chain.	96	56	P. Steel..	Plain...	Plain .	Roller...	1,400	1,000	36x1½	36x1½
Friction.	2	Motor...	2 Chain..	108	56	P. Steel..	Plain...	Plain..	Roller..	1,500	1,500	36x1½	36x1½
Friction.	...	Unit....	2 Chain..	96	56	P. Ste el.	....	....	....	2,200	1,000	34x2½	34x2½
Sel......	3	Unit....	Chain...	120	56	P. Steel..	Plain...	Ball...	....	.....	2,000	34x3½	34x3½
Sel......	3	Unit....	Shaft....	104	56	P. Steel..	Plain...	Ball...	....	.....	1,000	32x4½	32x4½
Sel......	3	Unit...	2 Chain..	110	66	P. Steel..	Plain...	Ball...	Roller..	5,000	6,000	36x5	36x4
Sel......	3	Unit...	2 Chain..	133	84	P. Steel..	Plain...	Roller.	Roller...	8,550	7,000	36x5	36x4
Sel......	3	Unit...	2 Chain..	132	56½	P. Steel..	Plain...	Roller	Roller...	.....	4,000	36x4	36x5
Plane....	2	Unit...	2 Chain .	130	62½	P. Steel..	Plain...	Roller.	Roller...	.....	6,000	36x5	36x4
Plane....	2	Unit...	2 Chain .	130	62½	P. Steel..	Plain...	Roller.	Roller...	.....	1,000	36x7	36x5
Sel......	3	Unit...	2 Chain..	115	56	Channel.	....	....	....	3,280	3,000	....	....
Plane....	3	J. Shaft.	2 Chain..	102	56	P. Steel..	Plain...	Plain..	Plain...	3,500	2,000	34x2½	34x2½
Plane....	3	J. Shaft	2 Chain..	102	56	P. Steel..	Plain...	Plain..	Plain...	4,000	4,000	34x3	34x3
Plane....	3	J. Shaft.	2 Chain..	108	56	P. Steel..	Plain ..	Plain..	Plain...	5,000	6,000	36x4	36x4
Plane....	3	J. Shaft.	2 Chain..	114	56	P. Steel.	Plain...	Plain..	Plain...	6,000	10,000	36x5	36x5
Sel......	3	Unit....	Shaft....	102	56	P. Steel..	Roller...	Roller.	Roller...	2,000	1,500	32x4½	32x4½
Sel......	3	Unit....	Shaft....	102	56	P. Steel	Roller...	Roller.	Roller...	2,600	....	32x4	32x4
Sel......	3	Unit...	2 Chain.	105	56	P. Steel.	Plain...	Roller.	Ball....	2,800	1,500	34x2½	34x2½
Sel......	3	Unit...	2 Chain..	115	62	P. Steel .	Plain...	Roller.	Roller...	4,000	2,000	36x3½	36x3½
Sel......	3	Unit...	2 Chain..	156	66	P Steel..	Plain...	Roller.	Roller...	6,200	6,000	36x4	36x3½
Sel......	3	Unit...	2 Chain..	156	68	P. Steel.	Plain...	Roller.	Roller...	7,000	6,000	36x5	36x4
Sel......	4	Unit...	Shaft ...	97	58	Ar. W'd.	Roller...	Roller.	Roller...	2,825	3,000	34x3½	34x4
Sel......	3	Unit....	2 Chain..	140	62	P. Steel..	....	....	....	5,900	6,000	....	....
Plane...	2	Unit....	2 Chain..	130	52	Channel.	....	....	....	3,000	4,000	36x5	36x6
Plane....	2	Unit....	2 Chain..	106	56	P. Steel..	....	....	....	2,300	1,000	....	....
Sel......	2	Unit....	1 Chain..	86	56½	....	....	....	....	.....	1,000	30x3	30x3
Sel......	3	Unit....	2 Chain..	98	50½	P Steel	....	....	....	2,700	2,000	32x4	32x4
Sel......	3	Unit....	2 Chain..	120	60	Channel.	....	....	....	4,600	6,000	36x5	36x3½
Sel......	3	Unit....	2 Chain..	140	66	Channel.	Plain...	Roller.	Roller...	6,000	7,000	36x4	36x3½
Sel......	3	Unit...	2 Chain..	130	60	Channel.	Plain...	Roller.	Roller...	4,900	5,000	36x3½	36x4
Friction.	4	Unit...	2 Chain.	128	58	Channel.	Plain...	Roller.	Plain....	4,500	4,000	34x3½	36x4
Friction.	4	Unit...	2 Chain..	100	56	Channel.	Plain...	Plain..	Plain....	2,200	2,000	40x2	38x2
Plane....	2	Unit....	2 Chain.	88	54½	Wood...	Plain...	Plain..	Ball....	1,375	600	30x3	30x3
Plane....	2	Motor...	2 Chain..	92	56	P. Steel..	....	....	....	2,600	1,000	32x4	32x4
Plane....	2	Motor...	2 Chain.	92	56	P. Steel..	....	....	....	2,600	1,000	32x4	32x4
Sel......	3	Unit....	2 Chain..	141	60	P. Steel..	....	....	....	4,200	3,000	36x5	36x5
Plane....	2	Motor...	2 Chain..	108	64	P. Steel..	Ball....	Ball...	Roller...	4,300	6,000	36x4	42x5
Plane....	2	Motor...	Shaft....	96	58	P. Steel..	Ball....	Ball...	Roller...	3,200	3,000	34x3½	36x4
Sel......	2	Unit...	2 Chain..	112	56	P. Steel..	Plain...	Roller.	Roller...	3,000	2,000	34x3	34x4
Sel......	3	Unit....	2 Chain..	124	58	P. Steel..	....	....	....	4,300	1,000	36x3½	36x4
Sel......	3	Unit....	2 Chain..	124	58	Channel.	....	....	....	5,400	6,000	34x4	36x5
Plane....	2	J. Shaft	Side Ch	100	56	Wood...	Plain...	Ball...	Ball....	1,750	....	37x2	40x2
Plane....	2	J. Shaft.	Side Ch .	100	56	Wood...	Plain...	Ball...	Ball....	1,800	....	37x2	40x2
Plane....	2	J. Shaft	Side Ch.	106	58	Wood...	Plain...	Ball...	Ball....	2,400	....	37x2½	40x2½
Plane....	2	J. Shaft.	Side Ch.	106	58	Wood...	Plain...	Ball...	Ball....	2,400	....	37x2½	40x2½
Sel	3	J. Shaft	Side Ch..	120	62	Wood...	Plain...	Ball...	Ball....	3,500	....	36x3½	36x4
Sel......	3	Unit....	Shaft....	113	56	P. Steel..	....	....	....	.....	1,000	34x4	34x4
Sel......	2	Unit....	2 Chain..	102	56	P. Steel..	....	....	....	2,600	1,500	36x2½	36x2½
Sel......	3	Unit....	Shaft....	100	56	P. Steel..	....	....	....	3,000	1,500	36x3	36x3
Plane....	2	Unit....	Chain...	96	56	P. Steel .	Plain...	Plain .	Ball....	2,200	....	....	....
Plane....	2	Unit....	Chain...	96	56	P Steel .	Plain ..	Plain .	Ball....	2 200	....	....	....
Commer.	3	Unit....	Chain...	132	63	P. Steel..	....	....	....	4,900	6,000	34x4	34x4
Commer.	3	Unit....	Chain...	132	63	Channel.	....	....	....	6,500	8,000	34x4½	34x4½
Commer.	4	Unit....	Chain...	144	70	Channel.	....	....	....	6,600	11,000	34x5½	40x5½
Commer.	4	Unit....	Chain...	144	70	Channel.	....	....	....	6,800	14,000	34x5½	40x5½
Plane....	2	Unit....	2 Chain	86	56	P Steel..	Plain...	Ball...	Ball....	1,600	....	36x2½	36x2½
Plane....	2	Unit....	2 Chain .	86	56	P Steel .	Plain...	Ball...	Ball....	1,600	....	36x2½	36x2½
Plane....	2	Unit....	2 Chain .	86	56	P. Steel	Plain...	Ball...	Ball....	2,000	....	36x2½	36x2½
Plane....	2	Unit....	2 Chain	86	56	P. Steel..	Plain...	Ball...	Ball....	2,000	....	36x2½	36x2½
Plane....	2	Unit....	2 Chain.	86	56	P. Steel..	Plain...	Ball...	Ball....	2,000	....	36x2½	36x2½
Plane....	2	Unit....	2 Chain	86	56	P. Steel..	Plain...	Ball ..	Ball....	2,000	....	36x2½	36x2½
Plane....	2	Unit....	2 Chain..	86	56	P. Steel	Plain...	Ball...	Ball....	2,000	....	36x2½	36x2½
Plane ...	2	Unit....	2 Chain..	86	56	P. Steel.	Plain...	Ball...	Ball....	2,000	....	36x2½	36x2½
Sel......	3	Unit....	2 Chain	112	60	P. Steel..	Plain...	Roller.	Roller...	5,500	4,000	34x5	34x3½
Sel......	3	Unit....	2 Chain..	100	56	P. Steel..	Plain...	Roller.	Roller...	3,700	2,000	32x4	32x4

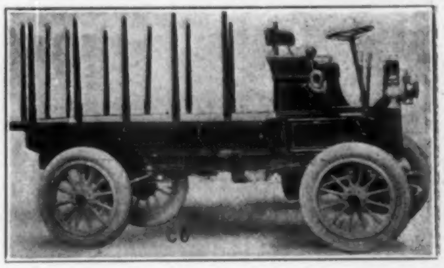
BRUSH—Brush Runabout Co., Detroit, Mich.
BUICK—Buick Motor Co., Flint, Mich.
C & B—Crane & Breed Mfg. Co., Cincinnati, O.
CARLSON—Carlson Motor Vehicle Co., Philadelphia, Pa.
CASS—Cass Motor Truck Co., Port Huron, Mich.
CHAMPION—C. F. Megow Co., Milwaukee, Wis.
CHASE—Chase Motor Truck Co., Syracuse, N. Y.
CINO—Haberer & Co., Cincinnati, O.
CLARK—Clark Power Wagon Co., Lansing, Mich.
CLARK—Clark Delivery Car Co., Chicago, Ill.
COLEMAN—Coleman Motor Car Co., Ilion, N. Y.
COMMER CAR—W. A. Wood Auto Mfg. Co., Kingston, N. Y.
CORTLAND—Cortland Wagon Co., Cortland, N. Y.
COURIER—Courier Car Co., Dayton, O.



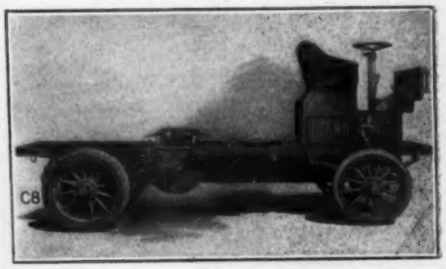
Buick platform, with cover and side curtains

Chase delivery wagon, with parcel body

Commer Car 5-ton truck, with Standard body



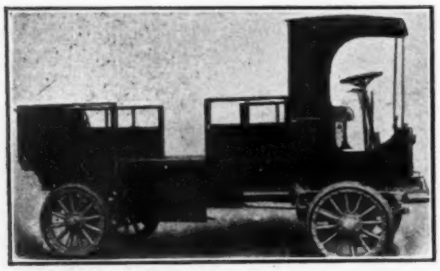
Franklin stake platform truck



Garford 2-ton chassis

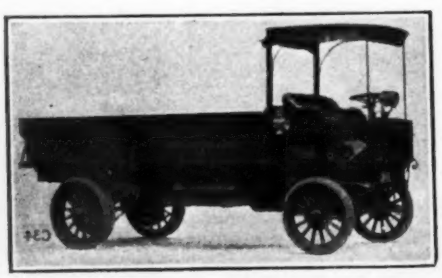
Details of Freight Automobiles

Grabowsky delivery wagon

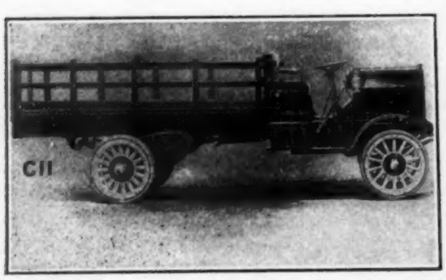


Gramm truck, with drop side for furniture

Hewitt 10-ton coal wagon



Kelly 3-ton packer's truck



Kissel Kar truck, with chain protectors

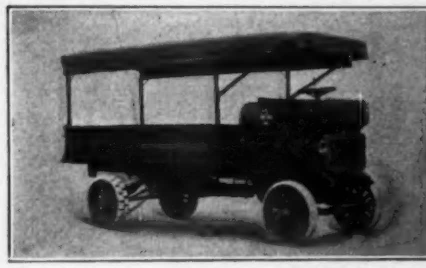
MAKES AND MODELS	Price	H.P	BODY	MOTOR				COOLING		IGNITION		Lubrication	Clutch
			Type	Cyl.	Bore	Stroke	How designed	Radiator	Pump	Magneto	Battery		
C. P. T.	$1000	20.0	Op. del.	2	5	4	......	Tubular.	Syph'n	......	......	F. feed.	M. Disc...
C. P. T.	1050	20.0	Can. top	2	5	4	......	Tubular.	Syph'n	......	......	F. feed.	M. Disc...
C. P. T.	1100	20.0	Pan top	2	5	4	......	Tubular.	Syph'n	......	......	F. feed.	M. Disc...
Crown	1250	22.0	Optionl	2	5¼	4	Pairs..	Tubular.	Cent'fl.	H. T.	......	F. feed.	M. Disc...
Decatur	1800	25.6	......	4	4	4	Single	......	Gear..	H. T.	......	F. feed.	M. Disc...
Denniston	2000	12.8	Optionl	2	4	4½	Block.	H'comb.	Gear..	H. T.	......	Splash..	M. Disc...
Doe Wah Jack	1200	20.0	Optionl	2	5	4½	......	Tubular.	Syph'n	H. T.	Storage	F. feed.	Cone.....
Dynamic	......	.....	Optionl	4	.....	.....	Block.	H'comb	......	H. T.	......	F. feed.	M. Disc...
Economy	......	16.2	Panel...	2	4½	5	Pairs..	Cellular..	Gear..	H. T.	......	F. feed.	Cone.....
Ewing A	......	36.1	Cl. del.	.	4¾	4¾	Pairs .	H'comb.	Cent 'fl	H. T.	Dry....	Splash..	M. Disc...
Federal	2100	32.4	Optionl	4	4½	4½	Pairs..	......	......	H. T.	......	Splash..	Cone.....
Fort Wayne	......	16.2	Optionl	2	4½	4½	......	Tubular.	Syph'n	H. T.	......	F. feed.	Cone.....
Franklin L-5	2500	18.2	Expres.	4	3⅜	4	Single.	Air cool..	......	H. T.	......	Splash..	M. disc...
Franklin L-5	2400	18.2	St. pfm	4	3⅜	4	Single.	Air cool..	H. T..	......	......	Splash..	M. disc...
Frontenac	3500	40.0	Optionl	4	5	5¾	Pairs..	Tubular.	Cent 'fl	H. T.	Storage	Splash..	Cone.....
Frontenac	3650	40.0	Optionl	4	5	5¾	Pairs..	Tubular.	Cent 'fl	H. T.	Storage	Splash..	Cone.....
Fuller	875	22.0	....	2	5¼	4	Single.	H'comb	......	L. T.	Dry....	......	M. Disc...
Garford B	3000	36.1	Optnal.	4	4¾	5¼	......	H'comb.	Cent 'fl	L. T.	Dry....	Splash..	Friction..
Gaylord	1250	25.6	Utility..	4	4	5	Pairs..	Tubular.	Cent 'fl	H. T.	Dry....	Sf con.	M. Disc...
Geneva C	1350	21.0	Deliv'y.	2	5⅛	4½	Single.	Tubular.	Gear..	H. T.	......	F. feed.	M. Disc...
Gleason	......	18.0	Optionl	2	4¾	4	Single.	Tubular.	Syph'n	H. T.	......	F. feed.	M. Disc...
Grabowsky	2300	24.2	Screen..	2	5½	5	Oppos.	H'comb..	None..	L. T.	......	F. feed.	Plate.....
Grabowsky	2650	24.2	Rack...	2	5½	5	Oppos.	H'comb..	None..	L. T.	......	F. feed.	Plate.....
Grabowsky	3050	24.2	Rack...	2	5½	5	Oppos.	H'comb..	None..	L. T.	......	F. feed.	Plate.....
Grabowsky	3500	28.8	Rack...	2	6	5	Oppos.	H'comb..	None..	L. T.	......	F. feed.	Plate.....
Gramm 1	1800	25.6	Optionl	4	4	5	Block.	H'comb	Cent 'fl	H. T.	Storage	Splash..	M. Disc...
Gramm 2	2500	28.9	Optionl	4	4¼	4½	Pairs .	H'comb.	Cent 'fl	H. T.	Storage	Splash..	M. Disc...
Gramm 3	3500	40.0	Optionl	4	5	5	Pairs..	H'comb..	Cent 'fl	H. T.	Storage	Splash..	M. Disc...
Gramm 5	4500	40.0	Optionl	4	5	5	Pairs..	H'comb .	Cent 'fl	H. T.	Storage	Splash..	M. Disc...
Hart-Kraft B	1175	16.2	Optionl	2	4½	4	Single.	Tubular.	Syph'n	L. T.	Dry....	Splash..	M. Disc...
Hart-Kraft C	2250	28.9	Optionl	4	4¼	4¾	Block.	Tubular.	Cent 'fl	H. T.	Dry....	Splash..	M. Disc...
Hart-Kraft D	3000	28.9	Optionl	4	4¼	4¾	Block.	Tubular.	Cent 'fl	H. T.	Dry....	Splash.	M. Disc...
Hatfield	850	18.0	Optionl	2	4¾	4	......	Air cool..	......	H. T.	......	Splash..	Friction..
Hewitt 2 Ton	2750	24.0	Optionl	2	5½	5	Single.	Tubular.	Syph'n	H. T.	None...	Pump..	Cone.....
Hewitt 3 Ton	3000	24.0	Optionl	2	5½	5	Single.	Tubular.	Syph'n	H. T.	None...	Pump..	Cone.....
Hewitt 5 Ton	5000	40.0	Optionl	4	4¾	6	Single.	Tubular.	Cent 'fl	H. T.	None...	Pump..	Cone.....
Hewitt 7 Ton	5500	40.0	Optionl	4	4¾	6	Single.	Tubular.	Cent 'fl	H. T.	None...	Pump..	Cone.....
Hewitt 10 Ton	6000	40.0	Optionl	4	4¾	6	Single.	Tubular.	Cent 'fl	H. T.	None...	Pump..	Cone.....
Ideal	1200	16.2	Optionl	2	4½	4½	Pairs..	Tubular	Syph'n	H. T.	......	F. feed	M. Disc...
Ideal	1650	22.0	Optionl	2	5¼	4½	Pairs..	Tubular	Syph'n	H. T.	......	F. feed	M. Disc...
Ideal	2100	25.6	Optionl	4	4	5	Pairs .	Tubular	Syph'n	H. T.	......	Splash.	Cone.....
International	......	20.0	Expres.	2	5	5	......	Air cool.	None..	H. T.	Dry....	F. feed	Band.....
Johnson	1500	28.9	Lt. del..	4	4¼	4½	Pairs..	H'comb..	Cent 'fl	H. T.	Dry....	Splash..	Cone.....
Johnson	2500	32.4	Stake...	4	4½	5¼	Pairs..	H'comb..	Cent 'fl	H. T.	Dry....	Splash..	Cone.....
Johnson	2000	28.9	Box....	4	4¼	4½	Pairs..	H'comb..	Cent 'fl	H. T.	......	Splash..	Cone.....
Johnson	3200	40.0	Stake...	4	5	5½	Pairs..	H'comb..	Cent 'fl	H. T.	Dry....	Splash..	Cone.....
Kato	3500	36.1	Stake...	4	4¾	5	Pairs..	Tubular.	......	H. T.	......	F. feed.	Cone.....
Kearns	1150	12.8	O. or Cl	2	4	4	Single	Syphon..	None..	......	......	......	....
Kelly	3300	30.6	Optionl	4	4⅜	5¼	Pairs..	None....	None..	H. T.	Dry....	F. feed.	Cone.....
Kelly	2800	30.6	Optionl	4	4⅜	5¼	Pairs..	None....	None..	H. T.	Dry....	F. feed.	Cone.....
Kissel Kar "T"	3500	38.0	Platf'm	4	4⅞	4¾	Pairs..	Tubular.	Cent 'fl	H. T.	Dry....	......	Cone.....
Knox R-5	3250	40.0	Optionl	4	5	4¾	Single	Cellular..	Cent 'fl	H. T.	Dry....	......	Dry Plate
Knox R-7	3400	40.0	Optionl	4	5	4¾	Single	Cellular..	Cent 'fl	H. T.	Dry....	......	Dry Plate
Knox G-14	3500	36.1	Optionl	4	4¾	5½	Single.	Air coold	None..	H. T.	Dry....	......	Dry Plate.
Knox R-14	3650	40.0	Optionl	4	5	4¾	Single	Cellular..	Cent 'fl	H. T.	Dry....	......	Dry Plate
Knox R-15	3850	40.0	Optionl	4	5	4¾	Single.	Cellular.	Cent 'fl	H. T.	Dry....	......	Dry Plate.
Knox R-16	4000	40.0	Optionl	4	5	4¾	Single.	Cellular..	Cent 'fl	H. T.	Dry....	......	Dry Plate.
Knox R-17	4200	40.0	Optionl	4	5	4¾	Single.	Cellular..	Cent 'fl	H. T.	Dry....	......	Dry Plate.
Knox M-3	4500	48.0	Optionl	4	5½	5½	Single.	Cellular..	Cent 'fl	H. T.	Dry....	......	Dry Plate
Knox M-4	4300	48.0	Optionl	4	5½	5½	Single.	Cellular..	Cent 'fl	H. T.	Dry....	......	....
Knox 64	3100	40.0	Optionl	4	5	4¾	Single.	Cellular..	Cent 'fl	H. T.	Dry....	......	....
Kopp	4800	57.6	Optionl	4	6	6	Single.	H'comb..	......	H. T.	Dry....	Sp. F. f.	Cone.....

C.P.T.—Chicago Pneumatic Tool Co., Chicago, Ill.
CROWN—Crown Commercial Car Co., Milwaukee, Wis.
DECATUR—Decatur Motor Car Co., Decatur, Ind.
DENNISTON—E. E. Denniston Co., Buffalo, N. Y.
DOE WAH JACK—Tulsa Auto Mfg. Co., Dowagiac, Mich.
DYNAMIC—Cleveland Motor Truck Mfg. Co., Cleveland, O.
ECONOMY—Economy Motor Car Co., Joliet, Ill.
EWING—Findlay Motor Co., Findlay, O.
FEDERAL—Federal Motor Truck Co., Detroit, Mich.
FORT WAYNE—Fort Wayne Auto Mfg. Co., Fort Wayne, Ind.
FRANKLIN—H. H. Franklin Mfg. Co., Syracuse, N. Y.
FRONTENAC—Abenroth & Root Mfg. Co., Newburg, N. Y.
FULLER—Fuller Buggy Co., Jackson, Mich.
GARFORD—The Garford Co., Elyria, O.
GAYLORD—Gaylord Motor Car Co., Gaylord, Mich.
GENEVA—Geneva Wagon Co., Geneva, N. Y.

on the American Market for 1911

TRANSMISSION				Wheelbase	Tread	Frame	BEARINGS			WEIGHT		TIRES	
Type	Speeds	Location	Drive				Crankshaft	Transmission	Axle	Of Car	Carry. Cap.	Front	Rear
Plan....	2	Unit....	2 Chain..	86	56	....	....	....	....	2,300	1,500	....	....
Plan....	2	Unit....	2 Chain..	86	56	....	....	....	....	2,300	1,500	....	....
Plan....	2	Unit....	2 Chain..	86	56	....	....	....	....	2,300	1,500	....	....
Sel......	3	Unit....	2 Chain..	104	56	P. Steel.	....	....	....	2,100	1,500	36x2½	36x2½
Sel......	3	Unit....	2 Chain..	129	56	P. Steel.	....	....	....	3,650	2,000	32x3	32x3½
Sel......	3	Motor...	Shaft....	94	56	P. Steel.	....	....	....	2,600	1,500	32x4	32x4
Plan....	2	Unit....	2 Chain..	104	56	P. Steel.	....	....	....	2,250	1,500	36x2½	36x2½
Sel......	2	Unit....	Shaft....	84	56	Channel.	....	....	....	3,500	3,000	....	....
Plane....	2	Unit....	2 Chain..	100	56	P. Steel.	....	....	....	1,850	1,000	....	....
Sel......	3	Unit....	2 Chain..	106	56	P. Steel.	Plain..	Ball ..	Ball....	.....	....	....	....
Sel......	3	Unit....	2 Chain..	110	56	P. Steel.	....	....	....	3,200	2,000	36x3½	36x3½
Plan....	2	Unit....	2 Chain..	100	56	P. Steel.	....	....	....	1,600	1,500	....	....
Prog....	3	Unit....	Shaft....	94	56	Wood...	Ball...	Ball...	Ball....	2,350	2,000	36x5½	36x5½
Prog....	3	Unit....	Shaft....	94	56	Wood...	Ball...	Ball...	Ball....	2,400	2,000	36x5½	36x5½
Sel......	3	Unit....	2 Chain..	122	53	Channel.	Plain...	Roller.	Roller.	6,600	6,000	36x5	36x4½
Sel......	3	Unit....	2 Chain..	122	53	Channel.	Plain...	Roller.	Roller...	6,600	8,000	36x5	36x4½
Plane....	2	....	Shaft ...	100	56	....	....	....	....	.....	1,000	36x2	36x2
....	...	....	2 Chain..	128	56	Channel.	Plain...	Roller	Roller..	4,600	4,000	34x3½	36x3
Sel......	3	Axle....	Shaft....	112	56	P. Steel.	Plain...	Roller	Roller...	2,300	....	32x3½	32x3½
Plane....	2	Unit....	2 Chain..	96	56	Wood...	Plain...	Ball...	Ball....	2,300	....	....	....
Sel......	3	Unit....	Shaft....	96	56	P. Steel.	....	....	....	.....	1,500	....	....
Plane....	2	Unit....	Side Ch..	102	56	P. Steel.	Plain...	Plain..	Roller..	.....	2,000	32x3½	32x3½
Plane....	2	Unit....	Side Ch..	127	56	P. Steel.	Plain...	Plain .	Roller...	.....	3,000	32x4	34x4
Plane....	2	Unit....	Side Ch .	127	56	P. Steel.	Plain...	Plain..	Roller...	.....	4,000	32x4	34x5
Plane....	2	Unit....	Side Ch .	127	60	P. Steel .	Plain...	Plain..	Roller...	.....	6,000	34x4	36x3½
Sel	3	Unit....	2 Chain .	90	56½	Channel.	Plain...	Roller	Ball ...	2,800	2 000	36x3½	36x3½
Sel......	3	Unit....	2 Chain.	124	60	Channel.	Plain...	Roller	Ball....	3,000	4,000	36x4	36x4
Sel......	4	Unit....	2 Chain.	124	66	Channel.	Plain...	Roller	Ball....	5,000	6,000	36x5	36x4
Sel......	4	Unit....	2 Chain.	130	69	Channel.	Plain...	Roller	Ball....	7,000	10,000	36x5	40x5
Plane....	2	Motor...	2 Chain .	78	56	P. Steel	Ball...	Roller	Ball....	2 450	1,500	34x2½	34x2½
Sel......	3	Unit....	2 Chain .	120	56	P. Steel.	Plain...	Roller	Ball....	3,550	3,000	34x3½	36x4
Sel	3	Unit....	2 Chain.	140	56	P. Steel.	Plain...	Roller	Ball....	4,100	5,000	34x4	38x3½
Friction.	...	Unit....	1 Chain..	94	56	P. Steel.	....	....	....	2,000	1,000	....	....
Plane....	2	Unit....	2 Chain..	112	60	Channel.	Plain...	Plain..	Roller..	4,200	4 000	34x4	34x3½
Plane....	2	Unit....	2 Chain..	136	60	Channel.	Plain...	Plain..	Roller...	4,600	6,000	34x5	34x4
Plane....	2	Unit....	2 Chain..	138	68	P. Steel.	Plain...	Plain..	Roller...	7,200	10,000	36x4	36x5
Plane....	2	Unit....	2 Chain.	138	68	P. Steel.	Plain...	Plain..	Roller...	7,600	14,000	36x5	36x6
Plane....	2	Unit....	2 Chain..	138	68	P. Steel.	Plain...	Plain .	Roller...	9,500	20,000	36x5	46x7
Plan....	2	Unit....	2 Chain..	100	56	P. Steel.	....	....	....	2,200	1,600	36x2½	36x3
Plan....	2	Unit....	2 Chain..	104	56	P. Steel.	....	....	....	3,000	2,500	34x3	34x3½
Sel......	3	Unit....	2 Chain..	116	56	Channel.	....	....	....	3,600	4,000	34x3½	34x4½
....	2	Unit....	Chain...	90	60	P. Steel.	....	....	....	2,000	1,000	41x1¾	45x1¾
Sel......	3	Unit....	Shaft....	112	56	P. Steel.	Plain...	Plain .	Ball ...	.....	....	32x3½	32x3½
Sel......	3	Unit....	Shaft....	108	66	P. Steel.	Plain...	Plain..	Ball ...	.....	5,000	36x4	36x4
Sel......	3	Unit....	2 Chain..	96	56	P. Steel.	Plain...	Plain..	Ball ...	.....	25,000	34x3½	34x3½
Sel......	3	Unit....	2 Chain..	132	72	P. Steel.	Plain...	Plain..	Plain ..	.....	10,000	36x5	36x3½
Sel......	3	Unit....	Shaft....	120	56	Channel.	....	....	....	5,200	6,000	34x5	34x5
Friction.	...	Unit....	2 Chain..	100	56	P. Steel.	....	....	....	.....	1,000	34x2	34x2
Sel......	4	Unit....	2 Chain..	136	66	P. Steel.	Plain...	Ball...	Roller..	5,300	6 000	36x4	38x4
Sel......	4	Unit....	2 Chain..	136	66	P. Steel.	Plain...	Ball...	Roller...	4,800	4,000	36x4	38x5
Sel......	4	Unit....	2 Chain..	144	68	P. Steel.	Plain...	Roller.	Roller...	6,600	7 000	36x4	36x4
Sel......	3	Unit....	2 Chain.	103	58	P. Steel.	Plain...	Ball...	Roller...	4,000	4,000	34x4	34x3½
Sel......	3	Unit....	2 Chain	125	58	P. Steel.	Plain...	Ball...	Roller ..	4,200	4,000	34x4	34x3½
Sel......	3	Unit....	2 Chain .	125	60	P. Steel.	Plain...	Roller.	Roller...	4,400	4,000	34x4	34x3½
Sel......	3	Unit....	2 Chain..	125	60	P. Steel	Plain...	Roller.	Roller..	4,640	4,000	34x4	34x3½
Sel......	3	Unit....	2 Chain..	149	67	P. Steel .	Plain...	Roller.	Roller...	5,830	6,000	36x4	36x4
Sel......	3	Unit....	2 Chain..	149	67	P. Steel.	Plain...	Roller.	Roller...	6,030	8,000	36x4	36x5
Sel......	3	Unit....	2 Chain..	149	67	P. Steel .	Plain...	Roller	Roller...	6,606	10,000	36x6	36x5
Sel......	3	Unit....	Chain...	128	60	P. Steel.	Plain...	Roller	Roller...	4,000	4,000	40x6	40x5½
Sel......	3	Unit....	Chain...	145	60	P. Steel.	Plain...	Roller.	Roller...	3,900	4,000	40x6	40x5½
Sel......	3	Unit....	Shaft....	136½	56	P. Steel.	Plain...	Ball..	Ball....	3,160	3,000	38x5½	38x5½
Sel......	3	Unit....	2 Chain..	126	68	Channel.	....	....	....	7,000	10,000	36x6	36x4

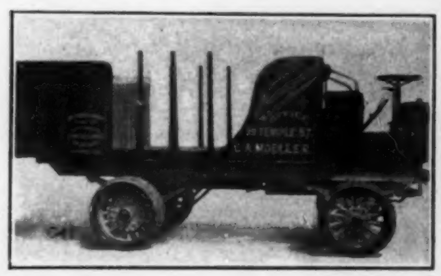
GLEASON—Kansas City Vehicle Co., Kansas City, Mo.
GRABOWSKY—Grabowsky Power Wagon Co., Detroit, Mich.
GRAMM—Gramm Motor Car Co., Lima, O.
HART-KRAFT—Hart-Kraft Motor Co., York, Pa.
HATFIELD—Hatfield Co., Cornwall-on-Hudson, N. Y.
HEWITT—Metzger Motor Car Co., New York.
IDEAL—Ideal Auto Co., Fort Wayne, Ind.
INTERNATIONAL—International Harvester Co., Chicago, Ill.
JOHNSON—Johnson Service Co., Milwaukee, Wis.
KATO—Fourtraction Auto Co., Mankato, Minn.
KEARNS—Kearns Motor Car Co., Beavertown, Pa.
KELLY—Kelly Motor Truck Co., Springfield, O.
KISSEL KAR—Kissel Motor Car Co., Hartford, Wis.
KNOX—Knox Automobile Co., Springfield, Mass.
KOPP—Kopp Motor Truck Co., Buffalo, N. Y.



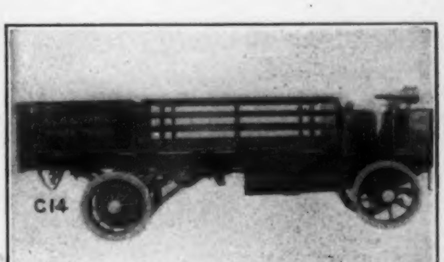
Knox 3-ton truck, Model R 15

Mack 5-ton truck

McIntyre 2500-pound truck



Moeller New Haven truck

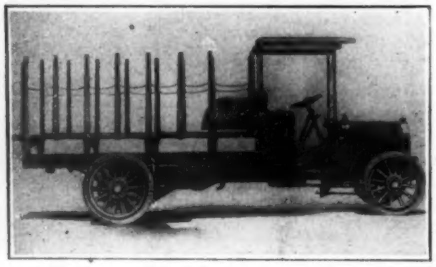


Morgan 5-ton truck

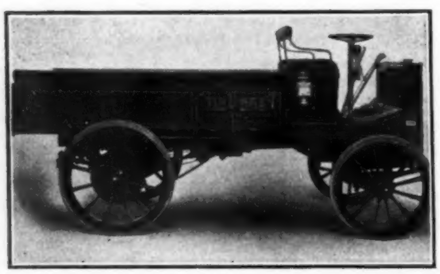
Details of Freight Automobiles

Overland Delivery Wagon

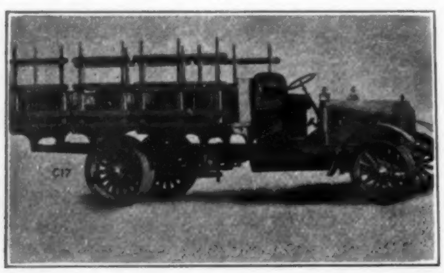
Packard 3-ton furniture van



Peerless 3-ton stake platform truck



Penn-unit truck, with removable unit sections



Pierce-Arrow 5-ton truck

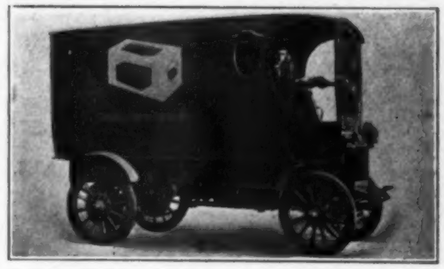
MAKES AND MODELS	Price	H.P	BODY	MOTOR				COOLING		IGNITION		Lubrication	Clutch
			Type	Cyl.	Bore	Stroke	How designed	Radiator	Pump	Magneto	Battery		
Lauth-Juergens	$1750	20.0	Expres.	2	5	5	Single	H'comb.	Syph'n	H. T.	Dry	F. feed	M. Disc
Mack	2500	32.4	Optionl	4	4½	5½	Tub.	H'comb.	Cent'fl	H. T.	Dry	S.-cont.	Cone
Mack	4000	48.4	Optionl	4	5½	6	Tub.	H'comb.	Cent'fl	H. T.	Dry	F. feed	Cone
Mack	4250	48.4	Optionl	4	5½	6	Tub.	H'comb'.	Cent'fl	H. T.	Dry	F. feed	Cone
Mack	4800	48.4	Optionl	4	5½	6	Tub.	H'comb.	Cent'fl	H. T.	Dry	F. feed	Cone
Mack	5200	48.4	Optionl	4	5½	6	Tub.	H'comb.	Cent'fl	H. T.	Dry	F. feed	Cone
Mars	2700	24.0	Expres.	4	3¾	5¼	Pairs.	H'comb.	......	H. T.	......	Splash.	Cone
Mars	3000	24.0	Expres.	4	3¾	5¼	Pairs.	H'comb.	......	H. T.	......	Splash.	Cone
Martin G-2	.....	14.5	Optionl	2	4½	5	Unit.	Tubular.	Syph'n	L. T.	Dry	Pump.	Ring
Martin G-3	.....	14.5	Optionl	2	4½	5	Unit.	Tubular.	Syph'n	L. T.	Dry	Pump.	Ring
Martin K	.....	28.9	Optionl	4	4½	5	Twin.	Tubular.	Cent'fl	L. T.	Dry	Sf. con.	M. Disc
Maytag 12	1175	20.0	Deliv'y.	2	5	5	Single	Tubular.	Eccen.	H. T.	Dry	F. feed	Cone
Maytag 10	1500	20.0	Deliv'y.	2	5	5	Single	Tubular.	Eccen.	H. T.	Dry	F. feed	Cone
Maytag 14	650	13.6	Deliv'y.	2	4⅛	4	Single	Air coold	None.	H. T.	Dry	F. feed	Cone
McIntyre XXI	1650	27.2	Optionl	4	4½	4	Single	Tubular.	Gear.	H. T.	Dry	Sf. con.	M. Disc
McIntyre XIV	1350	22.0	Optionl	2	5¼	4¾	Single	Tubular.	Gear.	H. T.	Dry	Sf. con.	M. Disc
McIntyre 211	800	18.0	Deliv'y.	2	4½	4½	Single	Air coold	None.	H. T.	Dry	Sf. con.	M. Disc
McIntyre 519	550	13.6	Deliv'y	2	4½	4½	Single	Air coold	None.	H. T.	Dry	Mech.	M. Disc
McIntyre U	465	13.6	Expres.	2	4½	4½	Single	Air coold	None.	H. T.	Dry	Mech.	M. Disc
Merit	1000	18.0	Open.	2	4½	4½	......	Air coold	......	......	......	Splash.	M. Disc
Moeller B	4500	32.4	Optionl	4	4½	5	Single	Tubular	Gear.	H. T.	Storage	F. feed	M. Disc
Monitor "B"	1400	22.0	Deliv'y.	2	5¼	4¾	Opp.	Tubular.	Syph'n	H. T.	Dry	Mech.	Cone
Monitor "A"	1500	22.0	Exp.	2	5¼	4¾	Opp.	Tubular.	Syph'n	H. T.	Dry	Mech.	Cone
Morgan	4750	40.0	Truck.	4	5	5	Block.	Cellular.	Cent'fl	H. T.	Dry	Pump.	M. Disc
Oliver	1500	20.0	Deliv'y	2	5	5	Single.	Tubular.	Syph'n	H. T.	None.	Mech.	M. Disc
Oliver	1650	20.0	Deliv'y.	2	5	5	Single.	Tubular	Syph'n	H. T.	None.	Mech.	M. Disc
Oliver	1500	20.0	Exp.	2	5	5	Single.	Tubular.	Syph'n	H. T.	None.	Mech.	M. Disc
Oliver	1600	20.0	Deliv'y.	2	5	5	Single.	Tubular.	Syph'n	H. T.	None.	Mech.	M. Disc
Overland 37	1000	22.5	Lt. del.	4	3¾	4½	Single.	Tubular.	Syph'n	H. T.	Dry	F. feed	M. Disc
Overland 37	1000	22.5	Expres.	4	3¾	4½	Single.	Tubular.	Syph'n	H. T.	Dry	F. feed	M. Disc
Overland, 1 T. Cru.	1500	28.9	Truck.	4	4¼	4½	Single.	Tubular.	Syph'n	H. T.	Dry	F. feed	M. Disc
Packard 3-T. Tru'k	3400	32.4	Optionl	4	4½	5½	Pairs.	Cellular.	Cent'fl	H. T.	Storage	F. feed	M. Disc
Peerless 3-T. Tru'k	.....	32.0	Optionl	4	4½	6½	Pairs.	Tubular.	Gear.	H. T.	Storage	Splash.	Cone
Peerless 4-T. Tru'k	.....	32.0	Optionl	4	4½	6½	Pairs.	Tubular.	Gear.	H. T.	Storage	Splash.	Cone
Penn-Unit	1800	20.0	Deliv'y.	2	5	5	Horiz.	Syph'n.	None.	H. T.	None.	F. feed	M. Disc
Pierce-Arrow	4500	38.0	Optionl	4	4½	6	Pairs.	Tubular.	Cent'fl	H. T.	Storage	Gravity	Cone
Plymouth	2100	28.9	Optionl	4	4½	5	Pairs	Tubular.	......	H. T.	Dry	Splash.	....
Randolph C-2	1850	22.0	Com'al.	2	5¼	4¾	Single	Cellular.	Syph'n	H. T.	Dry	Pump.	Cone
Rapid	.....	19.6	Optionl	4	3½	5¼	Block.	Tubular.	Cent'fl	H. T.	Storage	Pump.	M. Disc
Rapid	.....	25.6	Optionl	4	4	6	Block.	Tubular.	Cent'fl	H. T.	Storage	Pump.	M. Disc
Rapid	.....	36.1	Optionl	4	4¾	5¼	Twin.	Tubular.	Cent'fl	H. T.	Storage	Pump.	M. Disc
Rassel	1350	24.2	Expres.	2	5½	4¾	......	Tubular.	Syph'n	H. T.	......	F. feed	Cone
Reliance H	.....	32.0	Optionl	3	5¼	5½	......	Tubular.	Cent'fl	H. T.	Storage	Pump.	M. Disc
Reliance H-4	.....	32.0	Optionl	4	5¼	5	......	Tubular.	Cent'fl	H. T.	Storage	Pump.	M. Disc
Reliance K	.....	32.0	Optionl	4	5¼	5	......	Tubular.	Cent'fl	H. T.	Storage	Pump.	M. Disc
Reliance G	.....	32.0	Optionl	2	5¼	5	......	Tubular.	Cent'fl	H. T.	Storage	Pump.	M. Disc
Reliance G-3	.....	32.0	Optionl	3	5¼	5	......	Tubular.	Cent'fl	H. T.	Storage	Pump.	M. Disc
Reo H	750	9.0	Stake.	1	4½	6	Horiz.	Tubular.	Syph'n	None.	Dry	F. feed	M. Disc
Reo J	600	9.0	Expres.	1	4½	6	Horiz.	Tubular.	Gear.	None.	Dry	F. feed	M. Disc
Sampson	.....	18.0	Truck.	2	4¼	4¾	Oppos.	Tubular.	None.	H. T.	Dry	F. feed	M. Disc
Sampson	.....	25.6	Truck.	4	4	5	Vert.	Tubular.	None.	H. T.	Dry	F. feed	M. Disc
Sampson	.....	32.4	Truck.	4	4½	5½	Vert.	Tubular.	None.	H. T.	Dry	F. feed	M. Disc
Sampson	.....	32.4	Truck.	4	4½	5½	Vert.	Tubular.	None.	H. T.	Dry	F. feed	M. Disc
Sampson	4500	40.0	Truck.	4	5	5½	Vert.	Tubular.	None.	H. T.	Dry	F. feed	M. Disc
Sampson	5000	40.0	Truck.	4	5	5½	Vert.	Tubular.	None.	H. T.	Dry	F. feed	Cone
Sanbert	1500	19.2	Optionl	3	4	4½	Single.	Air coold	None.	H. T.	....	Splash.	M. Disc
S. and S.	3500	40.0	Optionl	4	5	6	Single.	H'comb.	......	H. T.	Dry	F. feed	Cone
Saurer "L"	5000	28.0	Optionl	4	4⅓	5.51	Pairs.	H'comb.	Cent'fl	H. T.	....	F. feed	Cone
Saurer "M"	6000	28.0	Optionl	4	4⅓	5.51	Pairs.	H'comb.	Cent'fl	H. T.	....	F. feed	Cone
Schacht	975	21.0	Expres.	2	5¼	4½	......	H'comb.	Syph'n	......	....	F. feed	Cone
Schacht	1435	30.7	....	4	4¾	5	Block.	H'comb.	Cent'fl	H. T.	....	F. feed	Cone
Schleicher	4000	40.0	Stake.	4	5	5½	Pairs.	H'comb.	......	H. T.	....	F. feed	Cone
Schleicher	6000	40.0	Stake.	4	5½	6	Pairs.	H'comb.	......	H. T.	....	F. feed	Cone

LAUTH-JUERGENS—Lauth-Juergens Motor Car Co., Fremont, O.
MACK—Mack Bros. Motor Car Co., Allentown, Pa.
MAIS—Mais Motor Truck Co., Indianapolis, Ind.
MARTIN—Martin Carriage Works, York, Pa.
MAYTAG—Maytag Mason Motor Co., Waterloo, Ia.
McINTYRE—W. H. McIntyre Co., Auburn, Ind.
MERIT—Waterville Tractor Co., Waterville, O.
MOELLER—New Haven Truck & Auto Works, New Haven, Conn.
MORGAN—R. L. Morgan Co., Worcester, Mass.
OLIVER—Oliver Motor Car Co., Detroit, Mich.
OVERLAND—Willys-Overland Co., Toledo, O.
PACKARD—Packard Motor Car Co., Detroit, Mich.
PEERLESS—Peerless Motor Car Co., Cleveland, O.
PENN-UNIT—Penn-Unit Car Co., Allentown, Pa.

on the American Market for 1911

TRANSMISSION							BEARINGS			WEIGHT		TIRES	
Type	Speeds	Location	Drive	Wheelbase	Tread	Frame	Crankshaft	Transmission	Axle	Of Car	Carry. Cap.	Front	Rear
Sel.	3	Unit	2 Chain	104	58	P. Steel				3,000	2,000	32x3	32x3½
Sel.	3	Unit	2 Chain	122	58	P. Steel	Plain	Roller	Roller	3,800	2,000	36x4	36x2½
Sel.	3	Unit	2 Chain	126	68	P. Steel	Plain	Roller	Roller	6,000	6,000	36x5	36x4
Sel.	3	Unit	2 Chain	126	72	P. Steel	Plain	Roller	Roller	6,600	8,000	36x5	36x4½
Sel.	3	Unit	2 Chain	126	72	P. Steel	Plain	Roller	Roller	7,200	10,000	36x6	36x5
Sel.	3	Unit	2 Chain	126	72	P. Steel	Plain	Roller	Roller	9,000	14,000	36x7	36x6
Sel.	3	Motor	Shaft	116	58	P. Steel				4,500	3,000	36x3½	36x3
Sel.	3	Motor	Shaft	124	58	P. Steel				4.800	4,000	36x4	36x3½
Plane	2	Unit	2 Chain	98	56	W. Iron	Plain	Plain	Roller	2,600	1,000	36x3	40x3
Plane	2	Unit	2 Chain	102	56	Iron	Plain	Plain	Roller	2,600	1,000	36x3	40x3
Sel.	3	Unit	2 Chain	146	60	Iron	Plain	Ball	Roller	3,500	6,000	36x3	40x3
Plane	2	Unit	2 Chain	100	56	P Steel	Plain	Roller	Roller	2 100		32x3½	32x3½
Plane	2	Unit	2 Chain	100	56	P. Steel	Plain	Roller	Roller	3,750		34x2½	34x3½
Plane	2	Unit	2 Chain	96	56	P. Steel	Plain	Plain	Ball	1,200		36x1½	36x1½
Plane	2	Unit	2 Chain	119	56	P. Steel	Plain	Plain	Roller	2,500	2,500	34x3	34x3½
Plane	2	Unit	2 Chain	94	60	P. Steel	Plain	Plain	Roller	2,000	2,000	34x2½	34x2½
Plane	2	Unit	2 Chain	86	56	P. Steel	Plain	Plain	Roller	1,900	1,200	34x1¾	34x2
Plane	2	Unit	2 Chain	77	56	P. Steel	Plain	Plain	Roller	1,250	600	34x1½	34x1½
Plane	2	Unit	2 Chain	77	56	P. Steel	Plain	Plain	Roller	1,200	500	34x1½	34x1½
Friction	4	Unit	2 Chain	88	56	P. Steel				1,900	1,000	35x2	35x2
Sel.	3	Unit	2 Chain	138	65	Channel	Plain	Roller	Roller	6,300	10.000	36x5	36x5
Sel.	3	Unit	Shaft	100	56	P. Steel	Plain	Roller	Roller	2,400	2,000		
Sel.	3	Unit	Shaft	100	56	P. Steel	Plain	Roller	Roller	2,400	2.000		
Plane	2	Shaft	2 Chain	141	64	P. Steel	Plain	Plain	Roller	9,000	10,000	36x6	36x5
Plane	2	Motor	Shaft	102	56	P. Steel	Plain	Plain	Roller	2,650		38x2½	38x2½
Plane	2	Motor	Shaft	102	56	P. Steel	Plain	Plain	Roller	2,725		38x2½	38x2½
Plane	2	Motor	Shaft	102	56	P. Steel	Plain	Plain	Roller	2,650		38x2½	38x2½
Plane	2	Motor	Shaft	102	56	P. Steel	Plain	Plain	Roller	2.800		38x2½	38x2½
Plane	2	Axle	Shaft	102	56	P. Steel	Plain	Roller	Roller	2,000	800	33x4	33x4
Plane	2	Axle	Shaft	102	56	P. Steel	Plain	Roller	Roller	2,000	800	33x4	33x4
Plane	2	Axle	Shaft	120	56	P. Steel	Plain	Roller	Roller	2,600	2,000	32x4½	32x4½
Sel.	3	Shaft	2 Chain	144	68	Channel	Plain	Ball	Roller	5,500	60,000	34x4	36x4
Sel.	4	Unit	2 Chain	151	70	P. Steel	Plain	Ball	Roller		6,000	36x4	40x4
Sel.	4	Unit	2 Chain	151	70	P. Steel	Plain	Ball	Roller		8,000	36x5	40x5
Sel.	3	Unit	2 Chain	90	56	P. Steel	Plain	Ball	Ball	2,800	1,500		
Sel.	3	Unit	Shaft	156	69	Channel	Plain	Ball	Roller	6,000	10,000	36x5	41x5½
Friction		Unit	2 Chain	123	56½	P. Steel					2,000	34x3	34x3½
Sel.	3	Unit	Chain	96½	58	P. Steel	Plain	Ball	Roller	2,800		34x3	36x3½
Sel.	4	Central	Chain	126	64	Channel	Plain	Ball	Plain	4,800	2,000	34x3	36x4
Sel.	4	Central	Chain	136	64	Channel	Plain	Ball	Plain	5,600	4,000	34x4	36x3½
Sel.	3	Central	Chain	138	68	Channel	Plain	Roller	Plain	7,500	6,000	36x5	36x4
Sel.	3	Unit	2 Chain	96	56	P. Steel					2,000	34x2½	34x3
Progress	3	Unit	2 Chain	140	65	P. Steel				6,400	7,000	36x5	36x3½
Progress	3	Unit	2 Chain	140	65	P. Steel				6,500	7 000	36x5	36x3½
Progress	3	Unit	2 Chain	138	69	P. Steel				7,600	10,000	36x6	36x5
Progress	3	Unit	2 Chain	122	62	P. Steel				5,200	5,000	32x4	32x3
Progress	3	Unit	2 Chain	122	62	P. Steel				5,300	5,000	36x4	36x3
Plane	2	Shaft	Unit	90	56	P Steel	Plain	Plain	Roller	1,750	1,500	36x2	36x2½
Plane	2	Shaft	Unit	78	56	An. Steel	Plain	Plain	Roller	1.400	500	28x3	28x3
Sel.	3	Unit	2 Chain	94	56	P. Steel	Plain	Roller	Roller	2,400	1,000	32x4	32x4
Sel.	3	Unit	2 Chain	110	56	P. Steel	Plain	Roller	Roller	4,000	2,000	32x3½	32x3½
Sel.	3	Unit	2 Chain	120	60	P. Steel	Plain	Ball	Roller	6,000	4,000	32x4	34x4
Sel.	3	Unit	2 Chain	144	68	P. Steel	Plain	Ball	Roller	7,000	6,000	34x4	36x4
Sel.	4	Unit	2 Chain	149	68	P.Steel	Plain	Ball	Roller	9.000	8.000	36x5	36x5
Sel.	4	Unit	2 Chain	155	70	P. Steel	Plain	Ball	Roller	10000	10,000	36x6	36x6
Plane	2	Unit	2 Chain	88	56	Channel				2,500	2,000	38x2½	38x2½
Sel.	3	Unit	2 Chain	156	62	P. Steel				5,400	6.000	34x4	34x4
Sel.	4	Unit	2 Chain	153	64	Channel	Ball	Ball	Ball	5,700	8,000	36x5	42x5
Sel.	4	Unit	2 Chain	153	64	P. Steel	Ball	Ball	Ball	6,800	12 000	36x5	42x6
Plan	2	Unit	2 Chain	103	60	P. Steel				1,700	1,000		
Sel.	3	Unit	Shaft	120	56	P. Steel				2.150	1,500	34x4	34x4
Sel.	4	Unit	2 Chain		78	P. Steel				5,500	6.000		
Sel.	4	Unit	2 Chain		78	P. Steel				7,500	10,000		

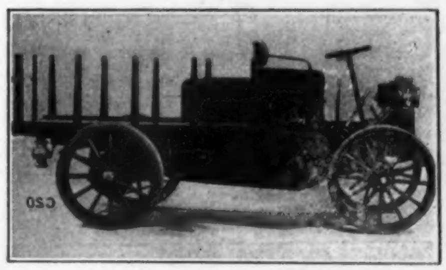
PIERCE-ARROW—Pierce-Arrow Motor Car Co., Buffalo, N. Y.
PLYMOUTH—Plymouth Motor Truck Co., Plymouth, O.
RANDOLPH—Randolph Motor Car Co., Chicago, Ill.
RAPID—Rapid Motor Vehicle Co., Pontiac, Mich.
RASSEL—E. C. Rassel Mfg. Co., Toledo, O.
RELIANCE—Reliance Motor Truck Co., Owosso, Mich.
REO—Reo Motor Car Co., Lansing, Mich.
SAMPSON—Sampson Mfg. Co., Pittsfield, Mass.
SANBERT—The Sanford-Herbert Co., Syracuse, N. Y.
S & S—Sayers & Scobille Co., Cincinnati, O.
SAURER—Saurer Motor Trucks, Chicago, Ill.
SCHACHT—Schacht Motor Car Co., Cincinnati, O.
SCHLEICHER—Schleicher Motor Vehicle Co., Ossining, N. Y.



Randolph box-delivery wagon

Rapid 60-H. P. 3-ton truck

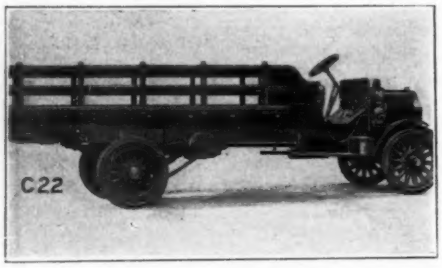
Reliance 3 1-2-ton truck



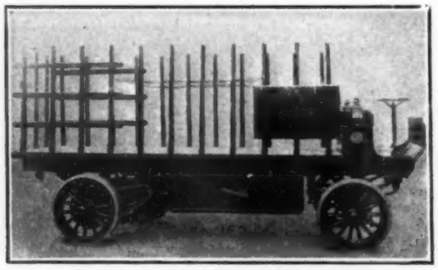
Reo Model H power wagon, with stake body

Sampson 4-ton truck

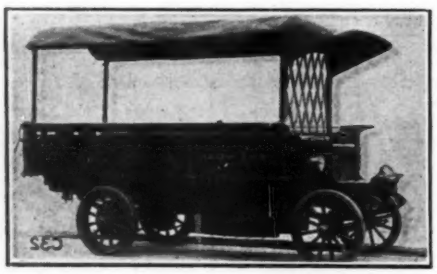
Details of Freight Automobiles



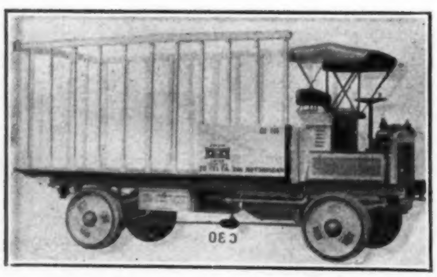
Stearns 3-5-ton truck, with platform body



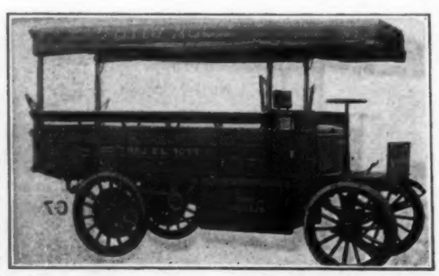
American 3 1-2-ton electric truck



Baker 2-ton wagon



Couple gear 3 1-2-ton truck, gas-electric



General Vehicle Co., 2,000-pound delivery wagon

MAKES AND MODELS	Price	BODY		MOTOR				COOLING		IGNITION		Lubrication	Clutch
		H.P.	Type	Cyl.	Bore	Stroke	Howdesigned	Radiator	Pump	Magneto	Battery		
Schurmeier C	.....	17.1	Exp ...	2	4⅜	5	Pairs..	Cellular..	Cent 'fl	H. T..	None...	Pump..	Cone.....
Schurmeier D	.....	28.9	Stake...	4	4¼	5	Pairs..	Cellular..	Cent 'fl	H. T..	None...	Pump..	M. Disc...
Sears "G"	$325	13.6	Po. box	2	4½	4	Single.	Air coold	None..	H. T..	Dry....	Splash..	None.....
Sears "H"	365	13.6	Po. box	2	4½	4	Single.	Air coold	None..	H. T..	Dry....	Splash..	None.....
Sears J	375	13.6	Po. box	2	4½	4	Single.	Air coold	None..	H. T..	Dry....	Splash..	None.....
Sears K	435	13.6	Po. box	2	4½	4	Single.	Air coold	None..	H. T..	Dry....	Splash..	None.....
Sears "L"	475	13.6	Po. box	2	4½	4	Single.	Air coold	None..	H. T..	Dry....	Splash..	None.....
Seitz	3500	40.0	Platf'm	4	5	5	Pairs..	Tubular.	Cent 'fl	H. T..	Dry....	F. feed.	None.....
Seitz	2800	32.4	Platf'm	4	4½	5	Pairs..	Tubular.	Cent 'fl	H. T..	Dry....	F. feed.	None.....
Seitz	2000	28.9	Platf'm	4	4⅛	4½	Pairs..	Tubular.	Cent 'fl	H. T..	Dry....	F. feed.	None.....
Stearns	3550	28.9	Platf'm	4	4½	5½	Block.	Cellular..	Cent 'fl	H. T..	Dry....	F. feed.	M. Disc...
Stegeman	3000	25.6	Crib....	4	4	4½	Pairs..	H'comb..	......	H. T..	....	F. feed.	M. Disc...
Stegeman	4000	25.6	Crib....	4	5	6	Pairs..	H'comb..	......	H. T..	....	F. feed.	M. Disc...
Sternberg	2400	24.2	Freight.	2	5½	5	Single.	Tubular.	Syph'n	H. T..	....	F. feed.	M. Disc...
Sternberg	3500	22.0	Freight.	4	5½	8	Pairs..	H'comb..	Syph'n	H. T..	....	F. feed.	M. Disc...
Stomberg F	1985	20.0	Stake...	2	5	5½	Opp...	Tubular.	Syph'n	H. T..	....	Sf. con.	M. Disc...
Stomberg 2-G	2400	20.0	Stake...	2	5	5½	Opp...	Tubular.	Syph'n	H. T..	....	Sf. con.	M. Disc...
Stuyvesant	1000	12.1	Box....	1	5½	6	......	Tubular.	Syph'n	......	....	F. feed.	Band.....
Sullivan	1100	14.5	....	2	4½	4	......	....	Syph'n	......	....	F. feed.	....
United States	2250	22.0	Optionl	2	5¼	4½	......	Tubular.	Syph'n	......	....	Pressur.	Cone.....
Utility	2000	28.9	Stake...	4	4½	5	Pairs..	H'comb..	......	H. T..	....	F. feed.	....
Utility	2000	40.0	Expres.	4	5	5½	Pairs..	Wright..	......	H. T..	....	F. feed.	....
Van Dyke	850	16.2	....	2	4½	6	......	Tubular.	Cent 'fl	......	....	F. feed.	....
Veerac	900	12.8	Expres.	2	4	4	......	Air coold	Cent 'fl	......	....	Splash..	Cone.....
Victor A	1650	20.2	Exp....	4	3¾	4	Pairs..	Tubular.	Cent 'fl	H. T..	Dry....	F. feed.	M. Disc...
Victor B	2500	32.4	Exp....	4	4½	4½	Pairs..	Tubular.	Cent 'fl	H. T..	Dry....	F. feed.	Cone.....
Victor C	3000	38.0	Exp....	4	4½	5½	Pairs..	Tubular.	Cent 'fl	H. T..	Dry....	F. feed.	Cone.....
Victor D	3500	44.1	Exp....	4	5¼	6	Single.	Tubular.	Cent 'fl	H. T..	Dry....	F. feed.	Cone.....
Victor E	4500	44.1	Exp....	4	5¼	6	Single.	Tubular.	Cent 'fl	H. T..	Dry....	F. feed.	Cone.....
Vulcan A	.....	14.5	Deliv'y.	2	4½	4	Single.	Tubular.	Gear..	H. T..	....	F. feed.	Cone.....
Vulcan B	.....	16.2	Deliv'y.	2	4½	4½	Single.	Tubular.	Gear..	H. T..	....	F. feed.	M. Disc...
Vulcan C	.....	14.5	Deliv'y.	2	4½	4½	Single.	Tubular.	Gear..	H. T..	....	F. feed.	M. Disc...
Walter	3200	25.6	Optionl	4	4	5	Pairs..	H'comb..	......	H. T..	....	F. feed.	Cone.....
Webster	.....	32.4	Optionl	4	4½	4	Block.	Air coold	None..	H. T..	....	F. feed.	Cone.....
White GBE	2100	22.5	Closed..	4	3¾	5⅛	Block.	H'comb..	Cent 'fl	H. T..	None...	Cent 'fl.	Cone.....
White GTB	3000	23.5	Choice..	4	3¾	5⅛	Block.	H'comb..	Cent 'fl	H. T..	None...	Cent 'fl.	Cone.....
Wilcox "I"	2300	28.9	Optionl	4	4½	4½	Pairs..	Tubular.	Cent 'fl	H. T..	Storage	Pump..	Cone.....
Wilcox "H"	2500	28.9	Optionl	4	4½	4½	Pairs..	Tubular.	Cent 'fl	H. T..	Storage	Pump..	Cone.....
Winkler	2000	28.9	Optionl	4	4½	4	Pairs..	Tubular.	Gear..	H. T..	....	F. feed.	M. Disc...
Winkler	4000	40.0	Optionl	4	5	5	Pairs..	Tubular.	Gear..	H. T..	....	F. feed.	M. Disc...

SPECIFICATIONS OF SOME OF THE COMME

MAKE AND MODEL	Price	BODY	MOTOR			BATTERIES		
			Number	H.P.	Locat'n	Type	No. Cells	Locat'n
American	....	Stake........	2	....	Divided	National.......	42	Middle...
Baker (3 Models)	2200	Express......	....	....	Middle..	9 P.V..........	42	Middle...
Capitol Car	1600	Delivery......	....	....	....	Edison.........	....	....
Commercial (6 Models)	....	Freight......	1	....	Middle..	Edison.........	42	Middle...
Detroit (2 Models)	2250	Delivery	1	....	....	Edison A-4.....	60	Middle...
General Vehicle Co. (5 Models)	....	Panel & Exp.	....	....	....	11 Plate G.V.S.	44	Und. frm
Lansden 76-A. (5 Models)	2350	Open Top....	One.	....	Rear...	Edison A-4....	60	Und-Slg.
Pittsburg (6 Models)	1200	....	1	....	Rear...	Optional.......	42	Middle...
Studebaker 25 (6 Models)	1875	Optional.....	1	....	Middle..	Exide 11 P.V.S.	26	Divided..
Ward O. (6 Models)	1200	Any..........	One.	1¼	Front..	A-4............	42	Middle...
Waverley (3 Models)	2250	Delivery.....	One.	....	....	11 Plate......	42	Chassis..

SCHURMEIER—Schurmeier Motor Car Co., St. Paul, Minn.
SEARS—Sears Motor Works, Chicago, Ill.
SEITZ—Seitz Auto & Transmission Co., Detroit, Mich.
STEARNS—The F. B. Stearns Co., Cleveland, O.
STEGEMAN—Stegeman Motor Car Co., Milwaukee, Wis.
STERNBERG—Sternberg Mfg. Co., Milwaukee, Wis.
STOMBERG—Stomberg Mfg. Co., Milwaukee, Wis.
STUYVESANT—Stuyvesant Motor Car Co., Cleveland, O.
SULLIVAN—Sullivan Motor Car Co., Rochester, N. Y.
UNITED STATES—United States Motor Truck Co., Cincinnati, O.
UTILITY—Stephenson Motor Car Co., South Milwaukee, Wis.
VAN DYKE—Van Dyke Motor Car Co., Detroit, Mich.
VEERAC—Veerac Motor Co., Minneapolis, Minn.
VICTOR—Victor Motor Truck Co., Buffalo, N. Y.
VULCAN—Vulcan Motor Car Co., Chicago, Ill.
WALTER—Walter Auto Truck Mfg. Co., New York.

on the American Market for 1911

TRANSMISSION							BEARINGS			WEIGHT		TIRES	
Type	Speeds	Location	Drive	Wheelbase	Tread	Frame	Crankshaft	Transmission	Axle	Of Car	Carry. Cap.	Front	Rear
Sel.	2	Unit	2 Chain	92	56	P. Steel	Plain	Roller	Roller	2,650		36x3	40x3
Sel.	3	Unit	2 Chain	112	56	P. Steel	Plain	Roller	Roller	4,500		36x4	36x3½
Friction		Unit	2 Chain	72	56	P. Steel	Plain		Roller	1,000		36x1¾	36x1¾
Friction		Unit	2 Chain	72	56	P. Steel	Plain		Roller	1,000		36x1¾	36x1¾
Friction		Unit	2 Chain	72	56	P. Steel	Plain		Roller	1,000		36x1¾	36x1¾
Friction		Unit	2 Chain	72	56	P. Steel	Plain		Roller	1,000		38x2	38x2
Friction		Unit	2 Chain	72	56	P. Steel	Plain		Roller	1,000		34x3	34x3
Friction		Unit	2 Chain	124	62	Channel	Plain	Roller	Roller	6,000	6,000	36x5	36x3½
Friction		Unit	2 Chain	118	62	Channel	Plain	Roller	Roller	5,000	4,000	34x4	34x2½
Friction		Unit	1 Chain	108	56	Channel	Plain	Roller	Roller	3,100	2,000	34x3½	34x3½
Sel.	3	Unit	2 Chain	144	60	P. Steel	Plain	Ball	Plain	6,000	8,000	34x5	38x4
Sel.	3	Unit	Chain	140	60	Channel				4,200	4,000	34x4	36x3
Sel.	4	Unit	Chain	156	68	Channel				6,500	12,000	36x6	40x5
Sel.	3	Unit	Chain	120	56	St. & W.				4,600	4,000	34x3½	36x4
Sel.	3	Unit	Chain	150	68	St. & W.				9,000	8,000		36
Sel.		S. Frame	2 Chain	110	56½	P. Steel	Plain	Roller	Roller	3,800	2,000	34x3	36x3½
Sel.	3	S. Frame	2 Chain	110	56½	P. Steel	Plain	Ball	Roller	4,500	3,000	36x3½	36x4
Plan.	2	Unit	Chain	108	56	P. Steel				1,850	1,200	34x3	36x3
Plan.	2	Motor	2 Chain	90	56					2,000	800		
	3			120	56	Channel				3,100	3,000		
Friction	4	Unit	2 Chain	110	56	P. Steel				3,200	2,000	40x3	40x3
Friction	4	Unit	2 Chain	136	60	P. Steel				6,100	6,000	42x5	42x5
Friction		Unit	Shaft	86	56	P. Steel				1,600	1,000	32x3	32x3
Plan.	2	Unit	2 Chain	82	56	P. Steel				1,700	1,000	36x2	36x2
Sel.	3	Unit	2 Chain	108	56	P. Steel	Plain	Ball	Roller	2,000	1,500	34x2½	34x2½
Sel.	3	Unit	2 Chain	144	62	Wood	Plain	Roller	Roller	4,200	4,000	36x3½	36x4
Sel.	3	Unit	2 Chain	150	62	Wood	Plain	Roller	Roller	6,000	5,000	36x4	36x3
Sel.	3	Unit	2 Chain	156	62	Wood	Plain	Roller	Roller	8,000	8,000	36x5	36x4
Sel.	3	Unit	2 Chain	156	62	Wood	Plain	Roller	Roller	2,250	10,000	36x3	36x5
Sel.	3	S. Frame	Shaft	124	56	P. Steel	Plain	Roller	Roller	2,400	1,000		
Sel.	3	S. Frame	Shaft	120	56	P. Steel	Plain	Roller	Roller	2,600	2,000		
Sel.	3	S. Frame	Shaft	130	56	P. Steel	Plain	Roller	Roller	3,000	4,000		
Sel.	3	Unit	2 Chain	124	58	P. Steel				3,600	4,000	36x3½	36x3½
Plan.	2	Unit	2 Chain	93	56	Arm'd					1,500		
Sel.	4	Unit	Shaft	100	56	P. Steel	Ball	Ball	Ball	2,535	1,500	34x4	34x4½
Sel.	4	Unit	Shaft	144	56	P. Steel	Ball	Ball	Ball	3,710	3,000	36x4	36x4
Sel.	3	Unit	2 Chain	117	56	P. Steel	Plain	Roller	Roller	3,300		36x3	36x3½
Sel.	3	Unit	2 Chain	117	58	P. Steel	Plain	Roller	Roller	3,700		36x3½	36x4
Prog.	3	Unit	2 Chain	107	56	P. Steel					2,000	34x3	34x3
Sel.	3	Unit	2 Chain	120	60	P. Steel					6,000	36x5	36x3½

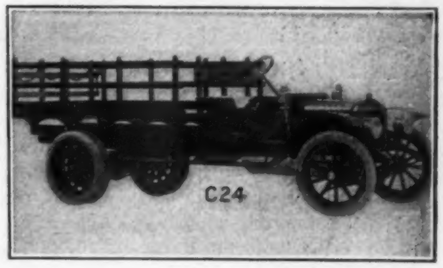
RCIAL ELECTRICS NOW ON THE MARKET

SPEEDS							BEARINGS					TIRES	
Forw'd	Reverse	First Reduction	Drive	Wheelbase	Tread	Frame	Motor	Transmission	Axle	Weight	Carrying Capacity	Front	Rear
		Chain	2 Chain	133	62	Ar. Wood				8,550	7,000	36x5	36x4
		Chain	2 Chain	85	56	P. Steel				2,500	1,000		
		Sil Ch.	1 Chain							2,670	1,000		
		Chain	Chain			P. Steel	Plain	Plain	Plain		500		
4	4	Sil Ch.	2 Chain	84	58	P. Steel	Roller	Roller	Roller	3,000	1,000	32x3	34x3½
4	2	Sil Ch.	Rol Chain	81½	55	P. Steel				3,490	1,000	36x2½	36x2½
3	2	Chain	Chain	88	56	Ar. Wood	Ball	Plain	Plain		1,000	32x2½	32x2½
		Sil Ch.	2 Chain	100	64	P. Steel					600		
4	1	Sil Ch.	2 Chain	83¾	57⅝	P. Steel	Ball	Ball	Ball			36x2½	42x2½
		Chain	Chain	97½	60	P. Steel				3,900	2,000	32x3	36x3
4	2	Chain	Chain	72	50	Armored	Ball	Plain	Roller	1,800	600	30x2	30x2

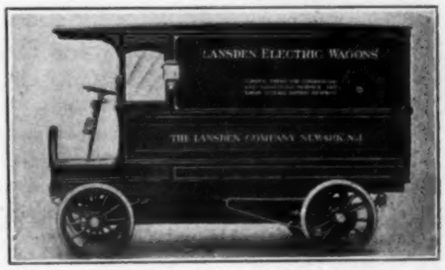
WEBSTER—Chicago Coach & Carriage Co., Chicago, Ill.
WHITE—White Co., Cleveland, O.
WILCOX—Wilcox Motor Car Co., Minneapolis, Minn.
WINKLER—Winkler Bros. Mfg. Co., South Bend, Ind.

ELECTRICS

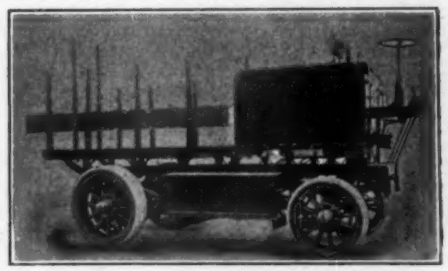
BAKER—Baker Motor Vehicle Co., Cleveland, O.
AMERICAN—American Motor Truck Co., Lockport, N. Y.
CAPITOL—Washington Motor Vehicle Co., Washington, D. C.
COMMERCIAL—Commercial Truck Co. of America, Philadelphia, Pa.
DETROIT—Anderson Carriage Co., Detroit, Mich.
GENERAL VEHICLE—General Vehicle Co., Long Island City, N. Y.
LANSDEN—The Lansden Company, Newark, N. J.
PITTSBURGH—Pittsburgh Motor Vehicle Co., New York City.
STUDEBAKER—Studebaker Automobile Co., South Bend, Ind.
WARD—C. A. Ward, New York City.
WAVERLEY—The Waverley Company, Indianapolis, Ind.



White "GTB" 1 1-2-ton truck, with platform body



Lansden electric truck



Studebaker electric stake truck

Ward Type "One" electric delivery

Waverley electric delivery wagon, Model 79

It Stands to Reason

SETTING DOWN SOME GROUNDS FOR COMPLAINT FOR THE APATHY OF THOSE WHO OUGHT TO KNOW BY NOW THAT HORSES DO NOT COMPARE FAVORABLY WITH AUTOMOBILES FOR HAULAGE PURPOSES

That those who have experienced the clogging-up effect of a heavy fall of snow will depart from horse-drawn vehicles as a mode of transportation before the next snowfall.

That it is not the cost of the vehicle that should be considered, but the cost of the delay instead, if the vehicle is incapable of doing the work expected of it.

That horse-drawn vehicles are not as good as freight automobiles under conditions of inclement weather.

That the loss commercially, due to poor transportation, may exceed the price of a freight automobile in one winter.

That the business of a firm cannot be expanded if deliveries cannot be made.

That the overhead charges of a firm cannot be kept down unless goods can be promptly delivered.

That the selling price of a commodity is affected by the time it must lay in storage awaiting a fine day so that horse-drawn vehicles can be put into service.

That the cold of Winter is as hard as the dead heat of the Summertime upon the life of horses.

That horsemen should not be expected to see any great advantage in freight automobiles.

That investigations on the part of merchants should be conducted by men who do not love horses.

That love is not the proper basis for estimating the value of the service that horses are capable of rendering.

That sentiment should enter into business; the man who loves horses should be glad to have them freed from the drudge work that freight automobiles are so capable of rendering.

That dead horses are too frequently forgotten in the calculations of cost.

That horses that are kept in the stable when snow is on the ground are commercially dead.

That horse-drawn vehicles devoted to short-haul work are on the half-dead list.

That the city of Paris displayed wisdom in its most trenchant form when it put horses to one side and substituted automobiles for street-cleaning service.

That sanitary considerations alone would be a sufficient reason for pensioning off horses; they do not properly belong on our city's streets.

That the builders of freight automobiles will have to conduct a campaign of education before they can expect the users to fall wholly into line.

That it is a weakness to make undue guarantees; the result is reverse to that which is aimed at.

That too much speed is at the bottom of the relatively high cost of operating some of the freight automobiles that are in service.

That it is poor policy to speed up freight automobiles just to attract the notice of chicken-hearted merchants.

That the industry must force chicken-hearted merchants into doing the right thing; this will naturally come if the automobiles in use do such good work that the merchants will be forced into buying, or go out of business.

That the life of an automobile is proportioned to the square of the velocity and to the weight.

That weight is not a serious factor in figuring the life of a freight automobile if the speed is held at a low level.

That speed is a killing matter if the weight also is very great.

That the man who wants to violate the speed law is the very person who will willingly violate every other law.

That the way for a merchant to fail in his new freight automobile venture is to demand high speed, large carrying capacity, and that his horsemen be put in charge of the newest acquisition—the freight automobiles.

That the merchant who thinks so much of his horsemen that he would risk his freight automobiles in their charge would get off for a small part of the cost by giving each of them $100 per month as a pension—make it for life.

That argument is futile—merchants have to learn in the school of cold, hard experience.

That the men who would be put out of a job are the ones who can put up the best argument in the world against freight automobiles.

That the cold, hard figures of arithmetic are not to be overcome by airy figures of speech.

That horsemen would make poor arithmeticians for the merchant who wants to fit out with freight automobiles.

That it is useless to say that a certain freight automobile has a carrying capacity of, say, one ton if, by measurement, the platform will hold two tons of merchandise.

That there should be a platform limit; not a say-so limit to the carrying capacity of an automobile truck.

That a furniture van will be overloaded if the ample platform is filled with pig iron.

That the man who loves horses will not care a hang how much a furniture van is overloaded.

That statistics obtained from a brewery are not of necessity accurate.

That the brewery-wagon driver, if he imbibes a glass of lager at each stopping place, will abuse his grandmother, let alone an automobile, before the day is over.

That it is a fallacy to count tire cost so assiduously that there is not time left to foot up the bill for oats and hay.

That the congestion in the city's streets will be reduced when the space now taken up by horses is vacated by them.

That the higher average speed that automobiles are capable of making will further reduce congestion.

That waiting in the line at the piers is partly a habit, and, to a considerable extent, due to the space occupied by horses.

That the way to keep a freight automobile in service is to give it "round house" attention every night.

That horses now get careful "round house" attention—they would lie down under the load within a week without it.

That a cheap little delivery wagon, simply because it is propelled by a gasoline motor, is not a truck.

That the average merchant would not go to a toy shop for a horse and wagon.

That the toy shop is a very favorite place for some merchants to call at when they wish to get their fingers burned.

That merchants are old in selling tea, but they are mere children when it comes to getting rid of horses.

That selecting an automobile truck is not a matter of counting money.

That merchants, when they purchase butter, know, by tests, whether or not it is uniform and not rancid. But they frequently select rancid vehicles.

Pointers

NEW YORK, Jan. 11—The first business session of the Society of Automobile Engineers for its 1911 annual meeting was convened at 9 o'clock in the morning at the Automobile Club of America, and the opening address by President Howard E. Coffin dealt at some length with the history, present undertakings, and future prospects of the Society, impressing the members with the importance of the present movement, which has for its object the final standardization of the materials that are being used in automobiles, it being the idea to cull, from the present too numerous list, such of the materials as may well be dispensed with, and more clearly defining the types of materials that are known to be generally efficacious in the various spheres to which they are assigned.

The opening of the professional session at 2 o'clock in the afternoon began with the reading of papers, and in order to more substantially indicate the scope and high aim of the papers presented this year they are reproduced with but slight abridgment, with a few exceptions they being of a character which has to do with certain phases of shop practice, the rules of racing, and such other matters, so that the date of publication can be deferred and still be timely.

The day's session, having concluded with preliminary business, such as the opening address of the president, report of the tellers of election of members, treasurer's report, annual report of the council, report of tellers of election of officers, discussion of proposed amendments to the society's constitution, terminated in the annual dinner which was scheduled for 7 o'clock in the evening and the menu, which is reproduced elsewhere in THE AUTOMOBILE, was discussed under favorable auspices and credit is due to the committee for its efficient work in this connection.

The Thursday session will open at 9 o'clock in the morning at the Automobile Club of America, and the first paper on the list is "The Construction of Highways for Motor Traffic," by Logan Waller Page, United States director of good roads, Department of Agriculture, to be followed by E. K. Roland's paper on leaf springs, after which the topic for discussion will be shock absorbers, and E. P. Batzell will then present his paper, "Novelties in Valve Systems," and, time permitting, H. N. Anderson will read a paper entitled "Hot Rolled Gears," to be followed by F. H. Floyd's paper, entitled "Commercial Gasoline and Impurities That Are Being Encountered."

The Thursday afternoon session will be professional in character, concluding Professor R. C. Carpenter's presentation of a test of a 20-horsepower Franklin air-cooled motor, to be followed by a paper entitled "Development of the Grinding Wheel," by George N. Jeppson, after which methods of grinding will be discussed by John C. Spence, and then Charles E. Duryea will make his presentation of the "Frictionless Friction Drive." Time permitting, the topic for discussion will be: "The Fire Protection Question," by N. B. Pope, and then A. L. McMurtry, chairman of the technical committee of the A. A. A., will discuss "Contest Rules That Affect the Engineer." This is to be followed by a discussion of a general character involving motor car contests, and it is proposed that Chester S. Ricker will present a paper entitled "Automobile Contests, Timing, and Coaching." The Thursday evening session will open at 8 o'clock, and will be professional in character, probably limited to a continuation of the work that will be started in the afternoon, and if time permits the question of the commercial vehicle will be taken up, and it is proposed to receive the report of the standards division committee on wood wheel dimensions, and fastening for solid tires, also standardization possibilities in the commercial car field, by W. P. Kennedy. E. A. Myers will talk about the advantages of the long-stroke motor, A. J. Slade will refer to foolproofing the commercial car, and Robert McA. Lloyd will refer to co-operation between the electric vehicle manufacturer and the central station; the ampere-hour meter for electric vehicles will have the attention of L. P. Lamphier.

The topics for general discussion will be as follows: "Vertical Motors under Foot-Boards versus Vertical Motors under Hood," introduction by B. D. Gray; "Proper Power and Speed of Gasoline Motors for Truck Purposes, and Proper Road Speeds for Vehicles of Different Capacities," introduction by P. H. Breed; "Chain Drive for Trucks and the Necessity of Housing Same," "Types of Transmissions for Trucks," "Gasoline-Electric Transmission for Heavy Loads," "Tire Mileage Costs," "Multiple Uses for Machines for Municipal Service."

Additional subjects will come up for discussion if the opportunity affords.

Perhaps the most important matter that will have the benefit of discussion at the annual meeting of the society this year has to do with the standardization of materials, such as steel of the various grades, and certain forms of castings, notable among which is aluminum. It will be impossible for the committee on standards to conclude its work, due to the fact that it has only considered the "tonnage" grades of steel thus far, thus leaving it for the immediate future to take up the sorting out and specifying of the finer grades of steel as used in the better class of automobiles, and the probabilities are that the report of the standards committee will not reach the council of the society in its final form before the approach of next summer's meeting. It is unfortunate, in a way, that so much time has to be taken in the disposal of the steel problem, but it is proper, nevertheless, to go as slowly as the occasion requires, thus avoiding the adoption of tonnage steel, and making it the standard, with the result that steelmakers would get the benefit of the name of quality without having to deliver the real article, and they could, of course, be relied upon to make the price match the name. As the matter stands, the council is watching it very closely, and the vast amount of work that has to be done by the standards committee before it will be in a position to make its final report is being carried forward as expeditiously as possible under the circumstances.

That the standards will be free from commercial bias when they are completed and accepted is one of the points that the council can be relied upon to look after.

Hot Rolled Gears

DISCUSSING THE HOT ROLLING OF GEARS FOR USE IN TRANSMISSIONS AND OTHER AUTOMOBILE WORK. BY H. N. ANDERSON, MEMBER OF THE SOCIETY OF AUTOMOBILE ENGINEERS; READ AT THE WINTER MEETING, JANUARY 11 AND 12, 1911

NEARLY four years ago, when the automobile industry was expanding by leaps and bounds and the capacity of the machine tools was the limiting feature, my attention was called to the fact that the shortage of the gear cutting machinery seemed to be the greatest, and at that time I conceived the idea of rolling the teeth in the rough blank hot, which idea upon investigation I found was not new, but had never been developed to a practical point. As to the development of the art, investigation brought to light the following facts:

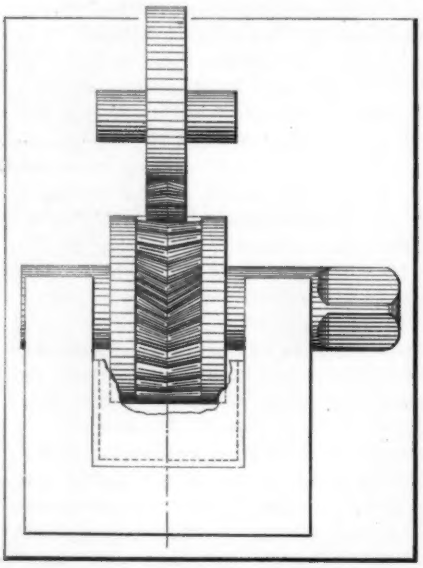


Fig. 1—The die driven in the Comly device, 1872

The knurling process was always used theretofore, that is, either the die was driven and the blank allowed to turn from its contact with the die, or the blank driven and the die allowed to turn from contact. The idea of rolling gear teeth in a blank first originated with John Comly as early as 1872. Comly shows the die driven and the blank rotating by contact (Figs. 1 and 2). F. A. Brun, a Frenchman, in 1905, showed the construction illustrated in Fig. 3; the blank being driven by frictional contact from the conical rolls 8, and the die 9 allowed to turn from contact with the blank. Brun took care of the surplus metal by the adjustment of the conical rolls 8, the idea being to force this extra metal down into the web of the gears. Chas. H. Logue, who has written a treatise on gearing, experimented with rolling gears; but his method was to take the blank and notch or rough it on a milling or hobbing machine, which gave the correct number of teeth and spacing; then taking the blank, heating it, and rolling the teeth to form. These operations would be more expensive than cutting the teeth to size in the first place.

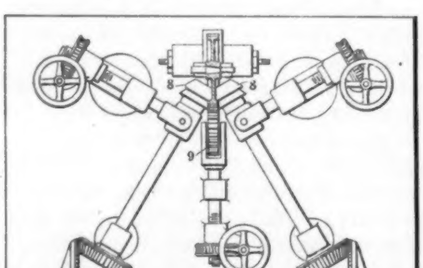


Fig. 3—Showing the construction of the Brun machine, 1905

I then built a small machine and experimented with rolling lead blanks, as the cold lead would flow the same as steel at a forging heat and required but a small amount of pressure. This showed conclusively that the tooth would form itself correctly. A large experimental machine was then built and steel gears, samples of which I have here for your inspection, were rolled successfully.

The machine in itself is very simple, as shown in the plan view. Fig. 4 comprises the driven shaft which drives through gears 14 and 12, shaft 11. On the end of shaft 11 is the break-down or roughing gear 13. On the shaft 4 is the finished gear 7; also a timing gear 6 which drives gear 23. This gear 23 is the same size as the blank to be rolled. This blank, marked X, is held between two chucks, 24b and 27b, which are opened and closed by a screw. The whole carriage 15, carrying chuck and gear, is pivoted on the pivot in line with edge of gear 23, and carriage is oscillated by means of screw 20 and handwheel 19.

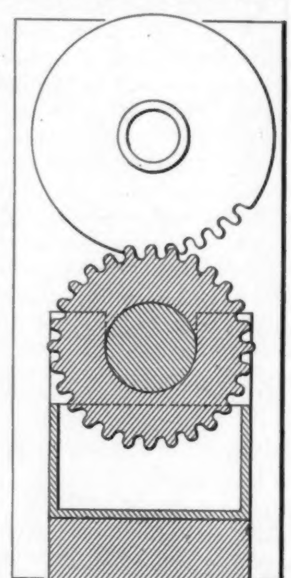


Fig. 2—Blank rotating by contact, Comly device

The Process Employed

The process is as follows: Blank X is inserted and the carriage is thrown over toward breakdown gear 13, which does the roughing work. This operation is very interesting, as the blank to be rolled is a little over the pitch diameter of the gear, the metal being broken up by this breakdown gear and then "flowed" out to a larger diameter. The blank is next brought into contact with the finishing gear 7, and carried up until the carriage reaches the stop mark 30; then the proper depth of tooth is reached and also the proper diameter; at the same time the surplus metal thrown out on the end of the teeth is trimmed off by cutter 31 by the movement of carriage by screw, operated by handwheel or lever, which brings edge of the gear X in contact with cutter 31. The gear is kept in this machine until it takes a permanent set, and is pushed off the holding arbor by a stripping device which cannot distort it.

The advantages of the process are:

1st. Cheapness, as the whole periphery of the gear is rolled in one or two heats, depending on the size of the blank. One gets an idea of the rapidity with which these gears can be made from the fact that a gear is in the machine for a period of not over forty-five seconds.

2nd. A much stronger tooth, caused by the in-

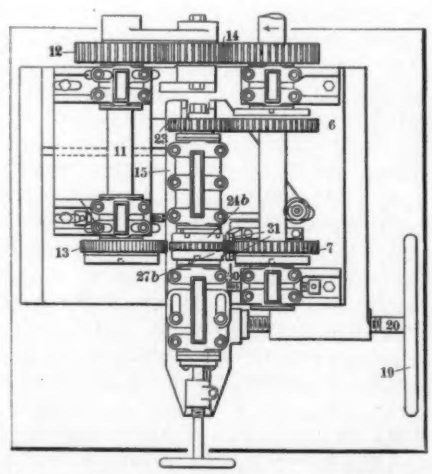


Fig. 4—Showing the plan of the Anderson machine

creased density of the metal, as each tooth is practically forged by an enormous side pressure on each flank.

3rd. A generated and developed tooth.

4th. The tendency to warp in case-hardening is a great deal less than with a cut gear, as the structure of the metal at the periphery is changed while hot and there are no internal strains to be relieved, as is the case of the cut gear, the periphery of which has been changed when the metal is cold.

5th. Any alloy steel gear, the blank of which can be drop-forged, can be rolled. With some silico-manganese steels which are practically impossible to machine, the blanks can have the teeth rolled and ground afterwards if desired; the hole being ground, making all operations forging and grinding.

6th. As the gears are held at the periphery and the hole is bored afterwards on a chuck which chucks from the pitch line of the teeth, the hole must be concentric with the pitch diameter, thus preventing a sprung arbor cutting an eccentric gear.

The rolling process applies to bevel as well as spur gears, in which case the cost is decreased far more.

In roughing a bevel with this process, the sides of the teeth have the true curve, with an evenly added amount of finish allowance. This is in contrast to the ordinary roughing machine which cuts a straight side on the teeth.

All gears where high accuracy is desired should have a finishing cut. The process described in combination with the gear grinding machine described by Mr. F. A. Ward, in a previous paper presented to the Society, would give, I believe, a cheaper gear that the present gear case-hardened; at the same time a stronger tooth and an accurate tooth. There is no question but that, with more development of this process, gears can be used in the lower-priced cars without any finishing cuts being required other than running the gears in properly.

Leaf Springs

DEALING WITH THE PROBLEMS OF LEAF-SPRING MAKING; GIVING FORMULAE; DISCUSSING SIZES; REFERRING TO HEAT TREATMENT, AND OTHER IMPORTANT RELATIONS. BY D. K. ROLAND, MEMBER OF THE SOCIETY OF AUTOMOBILE ENGINEERS; READ AT THE WINTER MEETING JANUARY 11 AND 12, 1911

THE object for which vehicle springs are used is first and mainly to prevent shocks, which arise from irregularities of road surfaces, from reaching the passengers; secondly, to prevent damage to the vehicle. The modern spring dates from 1804, when a patent covering elliptic springs was granted Obadiah Elliot.

Until the advent of the motor car the vehicle spring was divided, roughly speaking, into those for passenger carriages and those for transportation of merchandise, the main requisite of the first being ease of ride and of the second strength. When the motor became a commercial possibility the demand arose for springs combining ease and strength, which demand the spring-maker has endeavored to supply with more or less success.

The laws relating to the strength, deflection and resilience of springs are as follows:

The strength of a spring varies—

(1) Directly as the breadth of its plates. That is, double the breadth and you double the strength.

(2) As the square of the thickness of its plates. That is, double the thickness and you increase the strength four times.

(3) Inversely as its length. That is, double the length and you halve the strength.

(4) Directly as the number of plates. That is, the plates being all the same thickness, the strength of the spring is the strength of its main plate multiplied by the number of its plates.

The deflection of a spring plate under the load it will bear without taking a permanent set varies—

(5) As the square of its length. That is, double the length and you increase the deflection four times.

(6) Inversely as its thickness. That is, double the thickness and you halve the possible deflection.

(7) As the load. That is, double the load and you double the deflection.

The resilience of a spring varies—

(8) Directly as its weight or volume.

The rate at which a spring oscillates under any safe load varies—

(9) Inversely as the square root of the deflection produced by that load, or, for a given spring, inversely as the square root of the load.

Using the well-known formulæ of Reauleaux a spring may be constructed to carry with safety any given load, but at this point spring designing ceases to be a science and becomes an art, for the reason that the features of construction which produce ease of ride are covered by no formula; under this head I include the number of plates, their thickness and length, the length of the taper of each plate and resilience.

Assuming that a spring has been properly designed, the selection of proper material is of great importance, and the spring-maker is limited to three materials, chrome-vanadium, silico-manganese and what, for want of a better name, may be called open-hearth steel of the standard French analysis, of which the following is the composition:

Carbon	.60
Manganese	.70
Sulphur	.025 to .04
Phosphorus	.07
Silicon	.20% to .30%

Any of these materials properly heated possesses to a marked degree the necessary qualifications of a good spring steel, that is, high tensile and elastic limits with great elongation and reduction.

As an example of spring design I submit the following specifications for a standard seven-passenger touring car weighing between 3,750 pounds to 4,000 pounds. The dimensions given in all cases are under load.

Two and one-quarter inches wide, 38 inches long; the right spring to be of 150 pounds greater capacity than the left, as it has to take the torque of the motor.

Three-quarter scroll elliptic, 2 1-4 inches or 2 1-2 inches wide, the lower member to be 52 inches long, off-centered, not over 2 inches and to have an inside opening of not over 2 inches; the top member to be from 20 inches to 22 inches to center.

In seating the springs on the axle I strongly recommend a soft metal seat, although it is possible to obtain good results by the use of a leather pad not exceeding 1-16 inch in thickness; heavier leather or wood has a tendency to crush in service.

The spring clips should be of ample size and of a better material than ordinarily used. And the importance of keeping the clips tight cannot be over-estimated.

Commercial Gasoline

DISCUSSING THE IMPURITIES THAT ARE BEING ENCOUNTERED. BY F. H. FLOYD, ASSOCIATE OF THE SOCIETY OF AUTOMOBILE ENGINEERS.—PAPER TO BE READ AT THE WINTER MEETING, JANUARY 11 AND 12, 1911

MANUFACTURERS of automobiles and the domestic trade are asking a pertinent question: "What is commercial gasoline?" We have no standard to refer to. If we leave the matter to the refiner to formulate we never will have one. We need a standard for reasons that will become apparent later. It is the consuming trade that must take the initiative in formulating a standard. It must be intelligently formulated, carefully considering the refiner's position as well as our own. A great industry has been created. Internal combustion engines and the transmission of power generated have been applied to moving vehicles so scientifically, economically and with such control that the horse is almost a thing of the past as a power agent. Horsepower is literally supplanted by heat values stored up in gasoline.

What, now, is gasoline? Simply a trade name that came into use about 35 years ago, as a title for the light fractions distilled over from crude petroleum. Expressed by the Baumé scale, representing weight, it is anything from 87 gravity down to 60. It is lower yet in some sections, as you will find if you attempt to buy in some country stores fuel for your automobile. Commercial gasoline boils and distils over at a wide range of temperature. Its heat value and volatility vary, depending upon specific gravities, methods of refining and origin. It is a fuel little understood by the consuming trade, and the refiner is perfectly willing that it should be; for the demand has been heavy and the specifications are exacting, not always profitable to work under.

It will assist the designer of internal combustion engines used in automobiles particularly, and carbureter men as well, in their experimental work, if they will familiarize themselves with the source of supply, composition of the crude and methods of refining gasoline. Let us take them up.

Source of Supply

Sixty-one years ago, a man by the name of Drake drilled at Titusville, Pa., the first well, in search of crude petroleum, from which gasoline is recovered. At a depth of 400 feet he "struck oil." It came to the surface only and was pumped out. Two thousand barrels was the total production for the year 1859 from Pennsylvania and the United States. Let us follow the source of supply from the year 1859 to 1908, carefully, for we are vitally interested in the amount of gasoline that is produced in this country. Pennsylvania's production within the years given, stands as follows:

1859	2,000	barrels
1860	500,000	"
1870	5,260,000	"
1880	26,027,631	"
1891	33,009,236	"
1900	14,559,127	"
1908	10,584,453	"

Please note the rise and fall in production of the State of Pennsylvania.

Stimulated by the increased demand for the refined products, new fields were discovered in 1876, in Ohio, West Virginia and California. Following in their order came New York, Kentucky, Colorado, Indiana, Illinois, Kansas, Texas, Oklahoma and Louisiana. Dealing with the United States the production from the year 1859 to 1908 stands as follows:

In 1859	2,000	barrels
" 1869	4,215,000	"
" 1879	19,914,146	"
" 1889	35,163,513	"
" 1904	117,080,960	"
" 1908	179,572,479	"

For good reasons we must consider the contributions from the different states toward the grand total for the year 1908.

Pennsylvania produced	10,584,453	barrels
Ohio produced	10,858,797	"
West Virginia produced	9,523,176	"
California produced	44,854,737	"
Indiana produced	3,283,629	"
Illinois produced	33,685,106	"
Kansas produced	1,801,781	"
Texas produced	11,206,464	"
Oklahoma produced	45,798,765	"
Louisiana produced	6,835,130	"
New York produced	1,160,128	"

Other states, contributing less than 1,000,000 barrels, not mentioned.

The old fields, such as Pennsylvania, West Virginia and Texas, have declined in production, but new fields have been discovered and the yearly production total of the United States has increased from year to year. At the present time it does not appear that the yield of crude will lessen perceptibly for the next few years over the production of 1908, but will ultimately, the writer believes, and in the near future.

It will be important for you to note that Pennsylvania produced less than 6 per cent. of the entire crude of the country for 1908; that Illinois, Oklahoma and California produced nearly 70 per cent.; that we can no longer depend upon Pennsylvania for our supply as we did practically up to the year 1890, but must of necessity depend upon the gasoline produced from the crude of all of the states.

Crude petroleum, mineral oil or hydrocarbon oil (synonymous terms) recovered from the different states even from the different wells in the same states, is neither chemically nor physically alike. Neither are the distillates recovered, being affected by the character of the crude. The specific gravities of the various crudes as they are pumped from the different states will range all the way from 10 to 56 Baumé. The color of the crudes will vary from light amber to a jet black. It is the rule that the light-weight, light-colored crude is the great producer of gasoline and burning oils. The crude from Pennsylvania, for example, will average 40 Baumé, color light greenish, yielding about 20 per cent. of 60-gravity gasoline, and 14 per cent. of 65-gravity gasoline. The crude from Texas is entirely different, standing about 20 gravity, black in color and yielding less than 3 per cent. of heavyweight gasoline; so little, in fact, as to be hardly worth recovering.

Oklahoma crude will average about 34 Baumé, color somewhat greenish, yielding about 14 per cent. of 60-gravity gasoline and about 10 per cent. of 65-gravity gasoline. Illinois crude is somewhat dark in color, will average about 30 gravity, and yields about 12 per cent. of 60-gravity gasoline.

The California crude is of variable quality. Much of it will fall below 17 Baumé, producing no gasoline whatever; it is rich in asphaltum. Considerable crude has recently been discovered

that stands as high as 33 gravity, from which as high as 12 per cent. commercial gasoline can be recovered.

In dealing with the crudes of the United States we have a great variety of hydrocarbons classified under different groups. The lightweight crudes from Pennsylvania, for example, are saturated hydrocarbons with a paraffin base, while the dark and heavy crudes from California and Texas are unsaturated hydrocarbons with an asphalt base. Intermixed with crude, as it comes to the surface, will be found sulphur compounds, inorganic matter, brine and nitrogenous properties from the soil, all of which impurities should be eliminated in the process of refining commercial gasoline.

Let us see how this is done, and we will be better able to understand what impurities mean in commercial gasoline.

The mineral oil of hydrocarbon oil is drawn from the large settling tanks, carefully strained into the stills, the most improved resembling a boiler without flues. Above the stills are condensing coils directly connected. The oil is heated, the vapors rise (the most volatile first), and are condensed to a liquid and flow to the "tailhouse" where a number of switches are arranged to throw the distillates of various gravities to different tanks when desired for further treatment.

The hydrometer readings tell the operator when to switch. Naturally the first that comes over will be exceedingly light, say 88 gravity, gradually increasing in weight to 87, 70, 60 and 50 Baumé. When the entire distillate in the tank from first to last shows an average specific gravity that is desired, the operator switches, and the flow continues to another tank. This first cut, in the terminology of the refiner, is called crude benzine. Carried along with the distillate are many of the impurities that stood in the original crude. From the crude benzine we recover our gasoline and from now on in the process of refining the operator should be particular.

From the crude benzine tank the distillate is sent over to the agitators, cone-shaped tanks elevated with valves in the bottom, and connected up with compressed air. This crude benzine is now agitated with solutions of sulphuric acid and water, sometimes litharge, for the purpose of bringing down the sulphur compounds, nitrogenous matter, tar and other impurities generally, called sludge by the operator. This is drawn off at the bottom of the tank. Further treatment is continued by washing with caustic soda solutions and water. The entire treatment is called "sweetening." This can be well done or poorly done, depending upon the integrity of the operator. If poorly done the gasoline will still have a bad odor, and contain some of the sulphur compounds, inorganic matter and tarry bases, possibly show some traces of acid and alkali and contain moisture, all undesirable properties in gasoline. Some of the refiners of the midcontinent crude, Oklahoma crude, particularly, have recently adopted the practice of filtering the sweetened benzine through Fuller's earth. This is a great improvement in refining: for Fuller's earth is a great absorber of the heavy hydrocarbons, and, of course, other impurities as well. From the agitator the crude benzine goes to the steam stills to recover the gasoline and naphtha.

The process is much the same as before, using the steam still and the condenser, connected up with the commercial gasoline tanks, but in such a way that hydrometer readings can be made as the distillate goes over. Between the still and the condenser should be installed a trip for the purpose of catching the oily portion of the treated benzine and the heavy hydrocarbons and returning them to the still. They are very undesirable in commercial gasoline as will appear later. Following the process, the treated benzine is heated in the steam still; the vapors rise and are condensed. They are light at first, say 90 gravity, gradually get heavier as the flow continues, and will register 87, 80, 76, 70, 65 and 60-gravity gasoline. With the light and heavy all in one tank, the refiner stops when the whole shows a specific gravity that he desires to offer as commercial gasoline. That might be 68, 65 or 60. It is optional with him when he stops the stills and also whether he stops at 60.

He then switches the distillate, when through with gasoline, into the commercial naphtha tank, and distillation goes on. This will stop anywhere between 50 and 60 gravity, at his option. The residue is drawn off from the steam still to be used for other purposes.

Inasmuch as kerosene is a fuel used in stationary internal combustion engines, and will, the writer believes, be used in power trucks inside of the next year, I might state that it is the fraction that is distilled off after the crude benzine is recovered from the mineral oil. Simply a heavier distillate of 48 specific gravity. If treated in the same manner as gasoline and naphtha, the difference is one only of specific gravity, volatility and, of course, heat value.

Gasoline Specifications

Please note that where gasoline leaves off in distillation, and naphtha begins, is arbitrary with the refiner. If gasoline is worth more than naphtha, and it usually is, he can continue distillation for a longer period to the commercial gasoline tank, before making the cut to the naphtha tank, thus increasing his yield of gasoline; provided, however, that the purchaser does not restrict him by specifications of the gasoline he wishes to purchase. That is not true of kerosene, but the State laws specify what kerosene shall be, and the refiner must cut in and out at the proper time from his stills to get evaporative tests.

Refiners will tell you that gasoline ends at 60 and naphtha begins, but responsible refiners are putting out under the name of gasoline, a 58-gravity distillate.

Midcontinent refiners will tell you that their 58-gravity gasoline (?), particularly Oklahoma gasoline, is just as volatile as a Pennsylvania 62. If this be true, and in refining some crudes it is true, the purchase of gasoline by specific gravity alone is not consistent with quality.

Please note also that refiners can get gravities by mixing lightweight gasoline with heavyweight naphtha (light and heavy end mixing they call it), but will this give the gasoline we want for internal combustion engines? Decidedly not.

There do not seem to be any reliable data on the calorific value of distillates refined from crude petroleum, graduating from 85 Baumé gravity down to 48 and sold under the trade names of gasoline, naphtha and kerosene. The information that does apply is rather conflicting, possibly due to the variation in the samples obtained. Rather than favor one over the other (and the variation is not large when taken with a calorimeter) 19,000 B.T.U.'s per pound of fuel from 85 to 48 gravity is conservative and safe to figure on. Let us refer you to the following table:

SPECIFICATIONS OF THE VARIOUS FRACTIONS.

Fuel.	Specific Gravity.	Calorific Value per Pound.	Weight per Gal.	Calorific Value per Gal.	Carload Price F.O.B. Detroit, Nov. 1.
Gasoline	85 Baumé	19,000	5.42	102,980 B.T.U.	21c per gal.
"	75 "	19,000	5.69	108.110 "	15c "
"	68 "	19,000	5.89	111,910 "	10c "
Naphtha	58 "	19,000	6.20	117,800 "	8¼c "
"	50 "	19,000	6.48	123,120 "	6c "
Kerosene	48 "	19,000	6.55	124,450 "	4c "

Volatility is at a premium because the motor car designer demands it for the operation of his car in temperatures ranging from 95 degrees to zero; and the demand is heavy. Let me state that the volatility of the liquid fuel increases and decreases with the rise and fall in temperature.

Gasoline from 85 gravity down to 70 hardly comes under the head of commercial gasoline to-day. We find none of it on the market and it can be obtained from refiners only by special order. The refiners are loath to sell their lightweight gasoline,

claiming that they need this more volatile product to bring up the volatility of the heavier gravities that come over later from the stills, thereby increasing their yield.

The lightweight gasoline from 85 to 74 gravity is really more volatile than is necessary in operating a car. It is dangerous to handle and is easily wasted. Gasoline from 74 to 70 gravity in extreme cold weather would meet with considerable demand if it was on the market at reasonable figures, but it is not. Gasoline from 68 to 70 is quoted by some refiners, but it seldom reaches the 68 mark. Let us deal with fuels from 68 gravity down. At this gravity a well-refined straight run distillate, (one that comes over to the commercial gasoline tank from the steam stills, the cut being made when the gravity stands at 68), is sufficiently volatile to allow any of the carbureters of standard make to mix with it the air; a turn or two of the crank drawing a charge of volume sufficient, when ignited, to start the motor.

Velocity of flame propagation is sufficiently rapid throughout the mixture, if in the right proportions, to give complete combustion, or nearly so. The fuel is sufficiently active to permit of wide ranges of control of the car. Accumulation of deposits, whether carbon or otherwise, would result from sources outside of the fuel. Some of our leading automobile manufacturers specify 68 gravity gasoline and pay the extra price, purchasing in tank cars. Their engines are tested out on this gasoline and so are the carbureters. It might be in order to ask what the effect would be on cars that were tested out on 68 gravity and were sold in territories where 58 to 60 gravity fuel only was available. As a matter of fact commercial gasoline during the summer months will range from 58 to 63 gravity Baumé throughout the United States. The average will be 60. In the winter time this is raised about 2 degrees by the refiner, without notice. In the large cities the lightweight fuel prevails, country districts getting the heavyweight. Fractional distillation of much of the heavyweight (58 gravity), gasoline, sold particularly in the South and West, will show that it is as volatile as some of the 61 sold throughout the East. This is due to the character of the crude.

Let us see how efficient some of the 58 to 60 gravity fuel is in motor cars, quoting experience in one of our large manufacturing plants. During the hottest weather, 75 to 90 temperature, the cars were started with standard makes of carbureters easily, the volatility of the fuel being greater at this temperature. No complaints were made as to lack of power, control of the car or perfect combustion of the fuel. With the change in the weather to 60 degrees operators could not start their cars easily, and as the weather grew colder it became more difficult. Universally the statement was made that the cars ran all right after starting, implying that combustion was rapid and complete. If this was the case the fault was clearly with the carbureter in not delivering fuel to the cylinders at the start. It is not enough for carbureter manufacturers to state that it is the fault of the gasoline. We must have carbureters that will handle our commercial gasoline as we find it.

Design and heat are the resources of the carbureter men. Automobile manufacturers should be able to discriminate between carbureter efficiency and fuel efficiency. A poorly designed carbureter might condemn a first-class fuel. Experiments should be conducted with the less volatile distillates of naphtha and even kerosene—first, because they are cheaper, and second, because refiners tell us that with the years' increase in motor cars they will not be able to keep up volatility or gravities.

A conservative estimate of the yield of 68 gravity gasoline that might be obtained from 179,000,000 barrels of crude would be 8 per cent. and 12 per cent. of 58 gravity. In round figures 13,000,000 barrels of 68 and 21,000,000 barrels of 58.

Estimating that there were 200,000 cars in service in the United States previous to 1910, and that 150,000 cars were added in 1910, the demand for gasoline would run something like this: 350,000 cars traveling 4,500 miles, each consuming one gallon of gasoline to every 15 miles, and every car consuming 300 gallons yearly. A total of 105,000,000 gallons; 42 gallons to the barrel, 2,250,000 barrels yearly. Add another 150,000 cars in 1911, and the demand is for another 45,000,000 gallons, making a total of 3,260,000 barrels for horseless vehicles. Add to this the demand for motor boats, a large domestic trade, and a very large export business, and the amount produced for the year is consumed. Conservatively there were only about 10,000,000 barrels of gasoline produced last year. A great many thousands of barrels of crude were used for fuel oil. If kerosene can be used in motor cars there is available for fuel another 10,000,000 barrels.

Fractional Distillation

Some attempt has been made to purchase gasoline by gravity, but this is only relative, not specific. Fractional distillation will give us more information on the value of the fuel when we consider sources of supply.

Suppose we take the apparatus, or one similar, specified by the National Petroleum Congress, and the Engler method of distillation, drawing 100 cc. of fuel and distilling over at the rate of 10 cc. per minute, thermometer in the vapor. Record the temperature at the end of every 10 per cent., and to the end point.

In making deduction ignore the temperature at which the first vapor goes over the boiling point. Very light hydrocarbons are often intermixed with heavy and would appear quickly in the tube. It is better to use as a basis of estimate the point at which the first 10 per cent. goes over. When we are through we will know what the total evaporation of the fuel is within given temperatures. To illustrate let me give three fractional tests of fuel:

COMPARATIVE TESTS.

Specific Gravity Baumé	70.1	70	58
Distillation	1	2	3
Boiling Point	120 F.	88 F.	140 F.
10 Per cent. at	143 F.	140 F.	170 F.
20 " " "	153 F.	152 F.	178 F.
30 " " "	162 F.	161 F.	188 F.
40 " " "	169 F.	170 F.	195 F.
50 " " "	178 F.	182 F.	202 F.
60 " " "	185 F.	195 F.	210 F.
70 " " "	194 F.	212 F.	220 F.
80 " " "	205 F.	232 F.	235 F.
90 " " "	227 F.	260 F.	254 F.
96% " " "	257 F.	298 F.	278 F.

Glancing at the table the writer would call No. 1 and No. 3 short fractions, a homogeneous fuel, while No. 2 I would term a long fraction made up in all probability from light and heavy ends.

Discussing Fuel Efficiency Problems

Drawing a sharp line between carbureter efficiency in delivering fuel, and fuel efficiency in the cylinder, let us take up the latter, and we will, I think, come near to knowing what impurities mean in commercial gasoline. What is desired in a fuel for automobile internal combustion engines is:

1. Cheapness.
2. Greatest calorific value.
3. Rapid and complete combustibility under wide range of temperature surrounding the cylinder.
4. Fuel free from moisture, acidity, and alkali, and sulphur compounds.

The writer has enlarged upon the first two. Omitting the suggestion that motor truck designers experiment with kerosene, the fuel desired embraces the greatest calorific value with the least volume, and the lowest cost per gallon.

We know that we can get both rapid and complete combustion with volatile gasoline, from 70 to 85 Baumé. The problem of to-day is, what is the least volatile gasoline we can use and get both. Experimental departments should make exhaustive tests

analyzing waste gases, and make fractional tests of the fuel used.

Short fractions, those that vaporize within the shortest limits of temperature, are the most valuable distillates. No. 1 of the table is a better fuel than No. 2, both standing at nearly the same gravity. No. 3 at 58 gravity would undoubtedly prove as valuable a fuel as No. 1 in the cylinder, although a carbureter might not be able to handle it in extreme cold weather.

In the short fractions the velocity of flame propagation is much more rapid, and consequently we get greater power, and more perfect combustion. When fuels contain moisture, show acid or alkaline reaction, or sulphur compounds, it is due to improper treating of the crude benzine. Gasoline from the unsaturated hydrocarbons is more apt to hold in suspense those impurities, but the large refiners are reasonably careful in removing all traces.

If for any reason imperfect combustion of the fuel takes place in the cylinders during the process of decomposition, the carbon element (always hard to burn) is not converted into carbon dioxide, but is blown out with the exhaust; or in close muffling is often precipitated on spark plugs, cylinder heads, and mixed with the lubricating oil.

By improper feeding, surplus lubricating oil finds its way to the hottest parts of the cylinder, and slow combustion begins of this product. With some lubricating oils employed, particularly those that are refined from the unsaturated hydrocarbons, oxidation takes place. The process of polymerization is set up. The carbon element from the fuel, dust and dirt drawn in with the air on windy days through the carbureter, and foreign matter from other sources act as a nucleus around which the heavy hydrocarbons gather and adhere to the metal parts. Great care should be taken to install lubricating devices that feed just enough oil, and to the right places in the cylinders.

The automobile market is world-wide. Quick transportation is a problem for all nations to solve. The ox served its purpose at a mile and a half per hour a hundred years ago. This was better than putting one's shoulder to the wheel. The horse, at five miles per hour, was an improvement over the ox. The bicycle was a failure because the designer asked us to supply the power. The faster we wanted to go the faster we had to pedal, and the more heat value we used up. Put a motor on a cycle, and the machine is not a failure. A brilliant future is in store for it. The automobile is an improvement over all. The pessimist that thinks the farmer is extravagant in purchasing an automobile should be present when he breaks a plow-share, or his harvester, with twenty men in the field. In less than an hour he is back from town, perhaps twenty miles away, with the repair parts in his car. Eighteen hundred gallons of automobile fuel carefully purchased and used in a well-designed car is equivalent to the work of four sound horses in a year. We try to discriminate in purchasing the horse by asking his age, how much he weighs, what can he pull, whether he will bite or run away, or has any spavins, ringbones or the heaves. He has no objectionable qualities before purchasing, of course, but they sometimes develop afterward, and horsepower dwindles.

In purchasing our fuel let us be equally discriminating by inquiring the heat values, volatility and freedom from impurities. A discriminating buyer will make the seller more careful in methods of refining.

"Frictionless" Friction Drive

CHARLES E. DURYEA, MEMBER OF THE SOCIETY, TREATS OF ROLLER, SHAFT AND CHAIN TYPES OF DRIVES IN MOTOR OPERATION, GIVING RESULTS OF TESTS

HERE are possibilities well worth your attention which come quite reasonably within the above heading. I once asked a prominent automobile engineer his opinion of friction drives, meaning the usual disc type. He explained that they were frictional and lost too much power in that friction. This is a serious objection, but in spite of it they are doing good work in many instances, and their simplicity and sweetness of action commend them to many. They must be stiffly built and mounted in strongly braced frames; and in spite of these things they sometimes give trouble. To get the necessary strength they must have weight. And the friction coefficient is so low (around .25 if in good order and usually less, especially if dry or oily) that the pressures must be abnormally great. This means strong operating devices. Further they must be just in line, one with the other, or the driven disc will creep to one side or the other and add needless friction if resisted. These facts have been well set forth by writers on the subject.

We still have the query, "Is a friction drive that may be recognized as practically frictionless possible?" We know that bearings nowadays are made with fine steel balls, rollers or cones and so nicely fitted to suitable races that they are termed with good reason "anti-friction bearings." We know that the locomotive and the trolley car drive by friction of their wheels on the rails; just as does any self-propelled vehicle, with the difference that the steel wheel on the steel rail has very little resistance to rolling, practically no friction. Yet it is a friction drive if we take these words literally.

The term "friction drive" has come to be so universally applied to devices rolling in planes at right angles to each other and quite often adjustable as to the distance of one from the axis of the other, that I prefer to use the term "roller drive" when considering propulsion by the same plane wheel-on-the-rail type. We have therefore the needful elements for a motor drive free from the twisting found in the disc type. We are not limited in width of face, as is the usual friction device, and, having no teeth like on gears or sprockets, we may engage and disengage at will just as a friction clutch is used. Clearly here is something worth examination.

The locomotive drive method carries still another lesson. If it can drive from wheels on the crankshaft to the rail, why cannot the automobile be driven likewise? The auto can use endless rails attached to the wheels and drive directly from the crankshaft to them. This avoids carrying the power to the wheel hub, where it is largely force with little motion, but instead stops it near the wheel rim, where it is largely motion with little force. This in itself is a gain; for it saves the heavy, strong parts needed to resist the turning forces found near the wheel axis.

So in using this roller drive the first move is to bring the engine into a position where its shaft lies parallel with the rear axle and where wheels on the shaft ends may run on the tracks or rings attached to the vehicle wheels. We next arrange so that the driving and driven members (the rollers and rings) may be brought together at will. This may be done by swinging

either the engine or the vehicle axle. And this swinging must be accomplished by an amount of effort well within the capability of the average driver. Since the materials are steel against steel, one of which (the roller) is hardened for durability, it is evident that the amount of motion is not great and this permits the use of a lever to bring them together, this lever having eight times (more or less) the motion of the engaging parts. Use has shown that even with the movement required to engage a low and reverse drive this amount of motion is not excessive and the pressure required to drive a four-passenger surrey is not objectionably great. With two people aboard and the ratchet disconnected, a spring scale showed that on the level 10 pounds would drive (80 pounds at the roller contact points.) On a 13 per cent. grade 25 pounds was required; and in soft surface upgrade as much as 50 pounds was used; while still higher pressures are sometimes needed in very bad cases. The majority of the roads required less than 20 pounds, and but little more than 25 pounds took all the power of the engine on the high, although so easily is the ratchet lever set forward that it was found common to set the contacts much tighter than this in a hard pull. The low was not measured for the reason that hills up to the ability of the low were not easily at hand even in hilly territory. The low rollers are half the size of the high ones and so would require twice the pressure. The low rollers are by the side of the high rollers on the same shaft and are brought into position by telescoping the engine shaft-ends so as to bring them into the planes of the wheel rings.

The pressures selected as suitable for the service require the driving effect at the wheels to be sufficient to propel the vehicle. To get this, it was necessary to groove the rollers and rings. A number of angles were tried with more or less satisfactory results. Finally a groove of 40 degrees was adopted as being reasonably free from friction and yet of good pulling power. To secure ample surface for long life several small grooves are employed instead of a single one of large size. A further advantage is that the short surface angles have less friction loss by the slight twisting action of the surfaces on each other. Thus the friction surfaces are under 3-16-inch wide, six or eight in number, giving a friction surface 2 inches to 2 1-2 inches wide, with no part thereof more than 3-32-inch from the central line of neutral slip (not twist).

The amount of friction surface can be increased at will by adding more of these grooves, without increasing the loss. Thus the life of the device can be made as long as seems advisable, with no loss except the added weight and cost and the necessity of telescoping the shaft ends further in changing the ratios. If the twisting loss is made less by the use of narrower surfaces there is more danger of the roller running in the next groove instead of in its proper position; but this loses the use of one groove only and in no way affects the drive except that the life of the used grooves is slightly lessened. Since friction is largely independent of surface the drive is as perfect when one groove is used as when all are used. But the strength of the metal may not be high enough to resist the effort and the wear may be rapid.

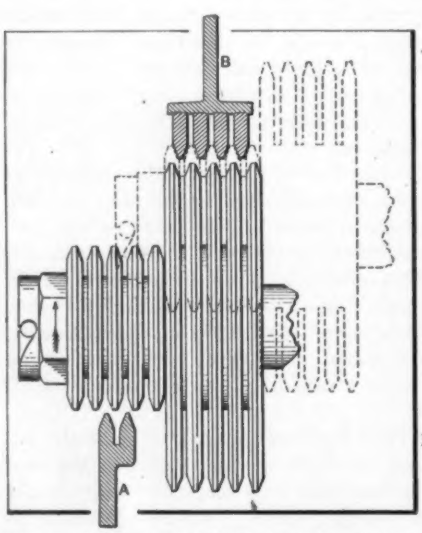


Fig. 1—Scheme of the frictionless friction drive

Having found these relations and facts and used the device very satisfactorily for some years, it became a matter of curiosity to know what the loss in this drive is. The engine was therefore removed and one roller and wheel left in place with a straight shaft in the place of the engine shaft. This shaft was mounted on the usual roller bearings and a string wrapped around it with a weight at its end sufficient to overcome the slight friction of the rollers. The wheel, being ball bearing, was carefully balanced and turned so easily that no appreciable weight seemed necessary to start it revolving. Having overcome these frictions it seems apparent that any resistance to revolution when the contact pressure is on must be due to the friction and pressure of the drive.

Since 50 pounds at the clutch lever was enough to take the full power of the engine on high at moderate speeds (doubtless the speeds of greatest torque) this condition was first reproduced. A rope was carried forward from one bearing of the roller shaft, over a pulley and 200 pounds of iron hung thereon. (Since this drive is a double drive, only half the total pressure comes on a single roller and ring.) With this pressure it was possible to raise 100 pounds from the floor, by a rope attached to the rim of the vehicle wheel, when the roller shaft was turned by the starting crank. It is not believed that this represents the full and usual ability with such a pressure, for the reason that neither the roller shaft nor the vehicle wheel had any appreciable momentum under such conditions. It is evident that neither the roller nor the ring is absolutely perfect and certain that some points would have a slightly greater frictional grip than others. In actual service, after the vehicle is started, the engine fly-wheel keeps the shaft which carries the rollers moving with a fairly steady angular velocity; while the weight of the vehicle acts as fly-wheel or a store of momentum for the vehicle wheel. The result is that in actual work an average frictional coefficient does perfect work, but in the test mentioned the minimum frictional ability had to be taken because, if not, at points of least friction the load would slip back, having no moving mass to continue it in motion past such points. Having determined, by repeated trials, the amount of load possible to lift, a string was wound around the wheel and by pulling it with a spring scale the force necessary to turn the wheel and shaft was ascertained. This was found to vary somewhat, but ran closely to 10 pounds. Running the string over a pulley and applying a weight would probably have been a more even way of ascertaining this force, but the distance required for the weight to fall excluded this method. Of the work done by the engine 10 pounds goes into turning the parts and 100 pounds into work done—a 9 per cent. friction loss.

In making this test, the wheel channel where the strings were applied measure 42 3-4 inches diameter, while the driven ring pitch line was but 32 1-2 inches diameter. To make the test more certain, a pulley had been fitted to the roller shaft bearing the same relation to the roller pitch line. Winding the string about the pulley gave the same pull as nearly as could be read. The load was also applied to this pulley and lifted by turning the wheel. These dimensions show that the driving ability at the pitch lines is greater than the 100 pounds lifted by a ratio of 13 to 10. So the actual tangential force at the pitch line radius was 130 pounds with a pressure of 200. This indicates a friction coefficient of 65, a vast gain as compared with the .11 of steel wheels on steel rails at 10 miles per hour. This gain in driving ability has of course been made by the grooving of the rollers and rings and at a loss of some part of the 9 per cent. total loss in this drive, part of which is in the bearings of the wheel and roller shaft; but the major part is due to the loss in the friction surfaces.

This coefficient is remarkable also when compared with the .18 to .27 of straw fiber and aluminum commonly used. But we must remember that this is the maximum high gear condition and not the usual condition. The next test was made with 100 pounds weight on the roller bearing, shaft rope, and it was repeatedly shown that 70 pounds could be lifted. The force required to turn the parts under this pressure was a scant 8 pounds, representing about 10 per cent. loss. The tangential force at the pitch line was 92 pounds, representing a friction coefficient of .92. This represents the pressure conditions under which a 13 per cent. grade was climbed and speaks for itself.

The next test was made with 50 pounds on the rope and represents the pressure needed to run on good roads of fairly level surface. Fifty pounds was lifted and about 4 pounds required to turn the parts. The friction loss is therefore about 7 2-5 per cent. of the total power expended in turning the shaft. The tangential pitch line force was 66 pounds scant, representing a friction coefficient of 1.31. These results from the two last tests show that the drive does not add to the duty required of the axle bearings, but actually takes therefrom. The power of the engine transfers a part of the weight of the vehicle to the driving rings and thus relieves the axle of carrying this amount. The effect is as if a passenger should get out of the vehicle and get his transportation by climbing upwards on the wheel spokes as the wheel revolved; with the difference that the roller drive, to get this effect, must apply pressure which the wheel bearings must take; but this pressure (less than the weight saved them) is applied horizontally and adds no wear or strain in the vertical direction.

The average of the three tests is an efficiency of 91 1-5 per cent., a loss of less than 9 per cent.

M. O'Gorman, a prominent engineer, before the British Society of Arts some years ago credited the single-chain drive (crank-shaft crosswise the vehicle) with 85 per cent. efficiency; the shaft drive with 69 per cent. and the same with jackshaft and two chains with but 50 per cent. to 58 per cent. efficiency. Compared with such figures (remember that the usual disc friction would be rated lower), you must admit that an efficiency of 91 1-5 per cent. is getting pretty well into the frictionless class. I have not mentioned or tested the low gear, for the reason that in my light high-powered, low-geared solid-tired vehicles this is seldom used. Months at a time with daily driving go by with no use of the low gear even for starting. The clutch action is so perfect and the power so ample that these rigs start on the high with no trouble or loss of time. If the rings are very severe there is a chatter like the chatter of a severe brake band, but this is no more a matter of concern than the brake chatter or the clash of gears and is easily stopped with little loss of ability by a slight application of oil or grease.

It is undoubtedly true that in this drive, as in all others, part of the friction is due to the pressure load on the bearings and the fact that the rollers and rings wear very slowly and have a long life, thousands of miles, bears out the tests, showing that there is not a great amount of friction between the surfaces. To test this point further, two weights of 50 pounds each were hung from the pulley on the roller shaft by a flexible cord and test weights applied till the shaft turned. Under this load the shaft turned much more steadily than with no load and did not feel the slight stiffness at points noticeable in the unloaded test. The weight needed to turn the unloaded shaft was first applied and the additional weight to turn the shaft with load was added. This was less than 1 pound (1 per cent.), and may have been as low as 1-2 per cent. because this test was hurriedly made and possibly not accurate.

The life of the roller drive device has not yet been established. Buggy-auts have been sold for four summers, but no rings considered of proper hardness have been replaced in that time. Cast-iron rings having four ridges (eight surfaces), were tried and wore out in 500 miles of severe work, with much slipping in starting and nursing the engine to avoid using low gear. Rings of soft steel will sometimes start cutting and tear themselves to powder in 1,000 miles or so. Generally they can be saved by a slight application of grease or graphite. But they chatter more frequently and have no advantage except that the rollers take hold with less pressure.

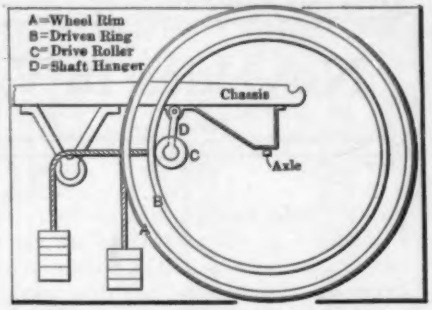


Fig. 2—Plan of use of the frictionless friction drive

The ridges are made of stock 3-16-inch thick and set with 1-16th clearance. The small roller is one piece, but the large rollers are built up of discs and spacers to avoid the difficulty of cutting the narrow grooves. They are of saw steel and hardened. The rings consist of a main body of T-iron electrically welded to length, carefully trued to a circle and turned on their inner surfaces, in which three or four slight grooves are cut. Into these grooves the wearing rings are placed. They are rolled edgewise to a true circle and simply snapped into these grooves by springing the ends sidewise and butting them together, followed by forcing them back into their plane. They are thus easily renewed when this becomes necessary. The reverse driven-ring is usually made of one solid piece turned to shape with no provision for renewal because the amount of use it gets will not wear it out in years.

This description fits the usual arrangement wherein the forward driven-ring is the larger one. In some instances the smaller ring is the one used for forward driving and in this case the wearing rings are welded to size and heated to expand them so that they may be gotten into their respective grooves, and then shrink tightly therein. This method is not considered the best because the rolling action may expand the rings and loosen them; and the friction loss is undoubtedly more because there is more twisting action when the roller is outside of the circle instead of inside, just as is true with external as compared with internal gears.

Some use has been made of an idler to drop into the roller and ring and transmit the power in a reverse direction. This is used in a type of light three-wheeled delivery cart. It saves telescoping the crankshaft extensions but is not considered the better way so far as it has been used. It offers a means of getting a considerable gear reduction, if made with its driven ridges of one diameter and its driving grooves of a smaller diameter.

In conclusion I would call attention to the fact that trolley car and locomotive practice have been followed not only in placing the crankshaft and in the roller type of drive but in the absence of a differential. These vehicles must carry their weight on their wheels and so any slipping of the wheels on the rails in turning corners is productive of considerable friction. But in the roller drive the pressure is not a large proportion of the weight under usual conditions and very little friction results from the slipping of a roller in turning a corner. Continued tests of these vehicles both with a roller releasing device and without have shown so little actual difference that the differential substitute has been abandoned with some gain in simplicity. On a very slippery asphalt street, with contacts tightly set, the steering wheels may show the need of a differential, but there is so much friction in most differentials that little choice remains.

Novelties in Valves

E. P. BATZELL, MEMBER OF THE SOCIETY, OUTLINES RECENT DEVELOPMENTS IN THAT LINE, INCLUDING COMBINATIONS OF ROTARY, POPPET, SLEEVE, PISTON AND OTHERS

IN the writer's paper, read at the S. A. E. summer meeting, a number of different types of valve arrangements brought forth to compete with the poppet valve were represented and discussed. During the last few months there have appeared some new valve systems, comprising among them also several constructions, embodying in their valve gear a combination of valve types, formerly known and applied separately. In regard to these there can be expressed a presumption that inventors found it hard to work the field seeking new original valve types, and started to combine older ones in one or the other way. As a result, the constructions became more and more complicated, and to redeem this it is necessary to make claims as to their great superiority over the others, simpler arrangements. Only a few of such combination valve systems are represented below, but it does not make it a hard problem to put different valve types together in some other manner.

Combination Rotary and Poppet Valve

Probably the most interesting of the combination valve systems is represented in Fig. 1. This system has been recently described in a number of trade papers, but for completeness a short description of it is also desirable here. It is a combination of rotary and poppet valve. The single poppet valve *a* is held to its seat *b* by the spring *c*. Inside the seat *b* is located the rotary valve *d* of cylindrical form, the central part *f* of which serves as guide for the poppet valve stem *g*. The cylinder inlet port is *i* and the exhaust *e*. The rest of the drawing clearly shows the method employed to secure combined operation of the poppet and the rotary valve. The timing of both valves is represented in Fig. 2, the exhaust duration being 231 degrees and that of the inlet 198 degrees of crankshaft movement. The port in the rotary valve extends about 114 degrees over its circumference, and the inlet and exhaust ports in the cylinder head each occupy about 80 degrees.

The claims made in favor of this system are as follows:

1. A single poppet valve of large size will insure ample opening with a minimum lift.
2. The induction and exhaust passages in the cylinder head can also be made of very ample area.
3. These two facts insure a rapid discharge of exhaust, resulting in a cool running engine, and similarly an easy flow and good charge of mixture are obtained on the induction stroke.
4. The rotary valve is entirely shielded from the compression and explosion pressures in the cylinder. The only pressure to which it is subjected is the slight negative pressure during the suction stroke. As lubrication of the rotary valve does not seem to present any difficulties, there ought to be no wear to speak of.
5. As the poppet valve remains open twice as long as is the case with the ordinary arrangement of two for each cylinder, and as the lift is less than half, it follows that the action must be much quieter and sweeter, and that wear and tear will be lessened accordingly.

In regard to these claims the following analysis can be made: To get the full advantage of port size in this system, the minimum lift of the poppet valve will have to be determined under consideration that the greatest openings of both valves be equal. It can be assumed that a motor with a 5-inch bore has a rotary valve of 3½-inch outside diameter and a poppet valve with 3⅛-inch clear diameter. The cylinder port openings which register with the rotary valve might be of rectangular section 1-inch high and extending, as said, over 80 degrees, having an area of about 3 square inches. Consequently, the poppet valve has to have a lift of about 5-16 inch. Again, to get all the advantage from a large size of valve opening, the poppet valve should not start to close the inlet before the moment when the cylinder port has been completely uncovered by the rotary valve. Referring to position 3 in Fig. 2, stating that the rotary valve opens the induction, and considering that 80 degrees of its motion is required to attain the maximum port size, it will be found that during but $114° - 80° = 34°$, counting half crank-shaft time, the poppet valve should close. On the other hand, in an ordinary poppet valve motor with the same opening duration, the corresponding time of valve closing will be 44 1-2 degrees, or about 30 per cent. of the total time slower. This rejects the claim made as to quieter and smoother valve action.

The shape of the respective inlet opening curve *a* in Fig. 3 is of a different character, comparing with valve systems described in the writer's former paper. The curve *a* is unsymmetrical, reaching its maximum quite late. Its rise is more gradual than with some other systems, but its drop is quicker. Concerning the inlet, a reversed form of curve should be preferred.

Less unfavorable is the exhaust. It is started by opening the poppet valve, which reaches its full lift during about 35 1-2 de-

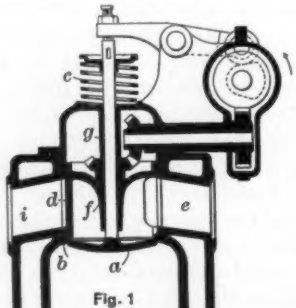


Fig. 1

Combination Rotary and Poppet Valve

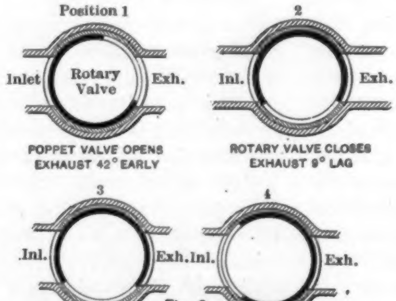
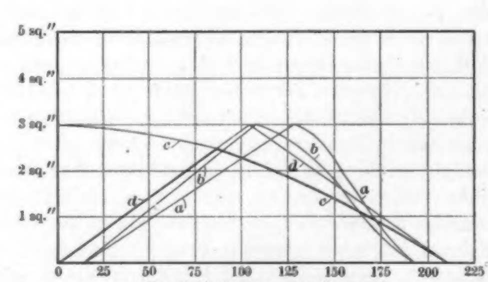


Fig. 2

Timing of Valve System Shown in Fig. 1



Inlet Opening Card

Fig. 3

Fig. 1—Diagram of a combination rotary valve in the head of the cylinder. Fig. 2—Scheme of opening of the valves. Fig. 3—Chart showing the crank-shaft movement in degrees referred to the inlet opening

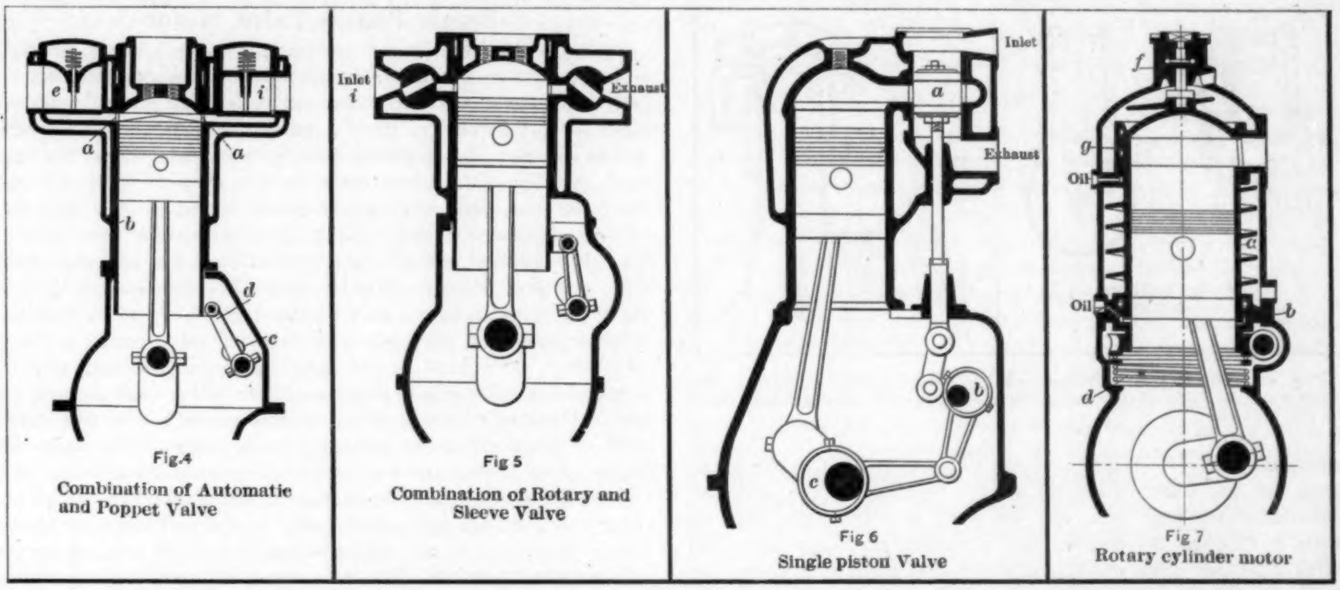


Fig. 4
Combination of Automatic and Poppet Valve

Fig 5
Combination of Rotary and Sleeve Valve

Fig 6
Single piston Valve

Fig 7
Rotary cylinder motor

Fig. 4—Section of a motor with a combination automatic and poppet valve. Fig. 5—Section of a cylinder, showing a combination rotary and sleeve valve. Fig. 6—Section of a cylinder showing a single piston valve. Fig. 7—Section of a rotary cylinder motor

grees of half-time motion, as compared with 57 3-4 degrees for an ordinary poppet valve. This quick exhaust opening really allows a quick and free escape of the burned gases. But with proper cam shape a similar quick opening, although of smaller total size, could be obtained in an ordinary poppet valve motor also.

The foregoing induces one to believe somewhat differently from what is stated in the claims accompanying the construction. However, some of its good features cannot be denied, and it might prove to be very reliable if applied in practice. A proper development of the oiling system for the rotary valve is not to be solved easily in such a manner as to prevent the oil from entering into the motor cylinder and the gas passages. A particularly bad feature of the system is the leading of intake and exhaust gases through the same chamber which is formed inside the rotary valve. In the foregoing example the volume of the chamber is about 9 cubic inches. With the motor having a 6-inch stroke, its piston displacement is 118 cubic inches, and its compression space of 25 per cent. of the total cylinder volume is about 39.5 cubic inches. During the induction stroke the 9 cubic inches of spent gases left in the valve chamber from the previous exhaust will be carried into the cylinder, thus increasing about 22 per cent. the amount of spent gases contained in the explosive mixture. After the inlet the space of 9 cubic inches is filled up by fresh gases, which are expelled wastefully during the following exhaust. For the chosen size of motor this will increase its fuel consumption about 10 per cent.

If it were not for the cited disadvantages in connection with a large chamber inside the rotary valve, the general valve action of the motor could be improved over that of the example taken. For instance, the same maximum size of 3-square inch inlet opening could be obtained with a cylinder port 1 1-2 inches high extending only 70 degrees over the rotary valve circumference. Retaining the 114 degrees extension of the port through the rotary valve, the difference $114° - 70° = 44°$ would be left as time of duration for the poppet valve to close. This figure is about equal to that of an ordinary poppet valve. The shape of inlet opening curve also would be somewhat improved—*b* in Fig. 3. However, these improvements are connected with an increase to 13 cubic inches of the chamber inside the rotary valve, due to higher ports therethrough. The volume of spent gases in the explosive mixture would be increased 31 per cent. over that in systems with separate inlet and exhaust passages. The fuel consumption would increase 15 per cent. In consideration of the above losses the shape of rotary valve as represented in Fig. 1 is a most unfavorable one. It could be improved by reducing the volume of the chamber inside of it. The losses will be decreased though not eliminated.

Combination of Poppet and Sleeve Valves

In Fig. 4 another valve combination is represented, comprising auatomatically acting inlet and exhaust poppet valves and a single sleeve valve. The action of it is as follows: At the beginning of the motor suction stroke ports *a* in the sleeve valve *b* are open and gas is admitted into the cylinder through the automatic inlet valve *i*. During the induction period the sleeve *b* starts an upward motion, being operated from a half-time shaft *c* by means of a connecting rod *d*. At the end of induction the ports *a* become hidden in the cylinder head, which cuts off this period. The sleeve *b* continues its motion up and afterwards down so as to start again to uncover ports *a* at the time of exhaust beginning. The pressure inside the cylinder forces the exhaust valve *e* open, allowing the gases to escape during the whole scavenging stroke. The alleged idea of this construction is to shield the poppet valves from high pressure and temperature and to get large valve openings together with simplicity of mechanism.

The opening character cannot be analyzed exactly, on account of the automatic valve action. Some figures relating to the sleeve valve timing are of interest. If its ports close the inlet with a 20 degree lag, and open the exhaust 40 degrees early, then the time between is 300 degrees, counting upon the crankshaft. The combined inlet and exhaust time will be the balance of 720 degrees or 420 degrees, during which the valve port *a* remains open. Its maximum opening is reached at the middle of this period, viz., 210 degrees after exhaust beginning. With an exhaust lasting 220 degrees it will be found that the sleeve *b* has traveled 10 degrees on its upward motion at the time when the inlet should start to open, respectively, when the piston starts its downward stroke. Thus the size of inlet opening given by the sleeve ports will decrease with the continued suction stroke. On the contrary, the automatic inlet valve *i* opens more and more due to increase of suction, caused by the rising piston velocity. Consequently there will be a moment somewhere between the extreme piston positions, when the port areas of both valves reach

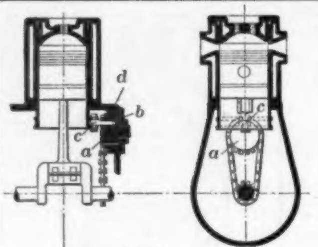


Fig.8
Combustion Oscillating and Sliding Sleeve

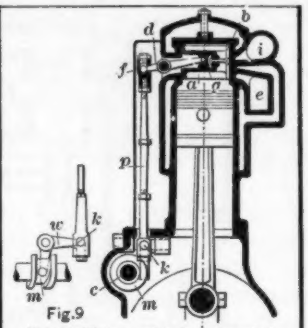


Fig.9
French Motor said to be successful

Fig. 8—Section of a cylinder, with a combination oscillating and sliding valve. Fig. 9—An idea from France that is regarded there as efficacious

an equal figure. This port area has to be considered as the maximum for the inlet. Contrary to the figuring of the inventor, this maximum port area will be much less than the area of ports *a* through the sleeve, and generally the automatic inlet valve does not open quickly, and the less quickly it opens the less will be the inlet port area maximum. Its value will be variable depending on the conditions under which the motor works.

Against the provision made for the exhaust in the above construction it can be mentioned that the automatic exhaust valve leaves a certain pressure above atmospheric inside the cylinder, after completion of the scavenging stroke. Investigating this point by means of a common indicator diagram, it will be found that with increase of this remaining pressure is required a longer piston travel on the suction stroke before the fresh charge can be taken into the cylinder. This results in a decrease of fresh charge quantity drawn in, together with an increase of the relative amount of spent gases mixed with it. The explosive mixture will be bad and the motor will have a low efficiency.

Combined Rotary and Sleeve Valves

The valve arrangement represented in Fig. 5 differs from that of Fig. 4 only in that rotary or oscillating barrel valves are used in place of the automatic inlet and exhaust valves of the latter. Let the change of sleeve valve port size during the inlet be represented by curve *c* in Fig. 3, and the lines *d* in the same figure correspond to the opening of the inlet rotary valve *i* in Fig. 5. The real shape of the opening curve with this valve combination will be represented by the starting part of line *d* until its intersection with curve *c*, after which it follows the latter. This resulting combination opening curve is shown in Fig. 3 by heavy lines. Its insufficient shape proportion is easily noticed, particularly if compared with that of the rotary valve.

Neither Fig. 4 nor Fig. 5 arrangements can be considered successful in any respect. The sleeve valve generally carries many strong objections against its use, and thus these objections become applicable also against the above constructions. The advantage of a favorable valve opening, which is being obtained with common rotary valves, is lost in the construction of Fig. 5 on the greatest part of the induction stroke. Mechanical complication is increased. As to the main object of these constructions, the shielding of the outer valves, this appears to be solved entirely in the wrong way. Poppet valves with a proper seat and stem cooling are more apt to withstand high temperatures than the sleeve valve. In regard to rotary valves this cannot be stated positively, although even the little work done with this type of valve induces one to not believe them less reliable than the sleeve valve. Properly constructed they will do the work under any heat conditions at present used in connection with automobile motors.

Single Piston Valve Motor

Ending this discussion of combination valve systems, it might still be proper to mention some new valve arrangements, not belonging to the combination type but embodying quite interesting ideas. Fig. 6 shows the general scheme of a single piston valve motor. The use of a single valve *a* for inlet and exhaust has been made possible in this construction by operating the valve through the compound motion of two eccentrics *b* and *c*. The interconnection of these eccentrics is such that during the latter part of the exhaust period and the early part of the inlet they assist each other and give the valve a quick motion. On the contrary, during the compression and part of the explosion periods both eccentrics counteract each other, so that the valve remains almost stationary. This kind of irregular motion is necessary on account of the difference in duration of the above said periods. It can be obtained either by using a combination piston and sleeve valve as described in the writer's former paper, or by using this single valve and a double eccentric opening mechanism. Of course the double eccentric motion is not limited to the piston valve only, but can be applied easily to the oscillating or sleeve valves, etc., also. In all cases the shape of valve opening curves will be quite favorable. The inlet curve will show a quick rise at the start and a more gradual closing. The exhaust will have the contrary—a gradual increase of valve velocity when closing.

The very curious construction shown in Fig. 7 hardly appears to be practical, but it is being claimed for it that it not only works but works well. Even believing this, it would be interesting to see some figures as to the quantity of oil consumed. The cylinder *a* is provided with valve ports in its top part and revolves itself, whereby the ports (or port) register with inlet and exhaust passages located through the surrounding waterjacket. The cylinder rotates at one-quarter crankshaft speed, which is rendered possible by using double inlet and exhaust ports. Its drive is through a worm and wheel and can be understood from the drawing. The top of the cylinder fits on a slight taper *g* into the adjoining part of the waterjacket housing. Oil under pressure of 6 pounds per square inch is led to this taper and also to the lower packing *b* as shown. The cylinder *a* has spiral fins outside, which should assist the water circulation. The oil, being led to places as indicated, besides serving as lubricant, should also prevent the jacket water from penetrating into the crankcase through the packing *b*, and into the cylinder through the taper joint *g*. For the latter purposes the oil should be supplied in abundance, so that its flow overpowers the tendency of the water to penetrate into the joints, on their whole circumference. Thus it can be anticipated that a great part of the oil supply is wasted into the waterjacket, the rest of it being burned and carried away by the exhaust gases.

It is also being claimed for the construction of Fig. 7 that the taper joint *g* of the cylinder head is self-regulating, because the spring *d* has a tendency to push the whole cylinder upward. On the other hand, the ball thrust bearing *f* in the top takes up this spring pressure and also the explosion pressure acting from the cylinder inside against its top. Such being the case, the wear in the joint *g* can be taken up only by hand adjusting bearing *f*, because it is hard to presume that the wear in this bearing will equal that in the joint.

Combined Oscillating and Sliding Sleeve Valves

Construction after Fig. 8 represents a certain interest because it employs a combined sliding and oscillating motion for its sleeve valve. The construction, which is more or less clear from the drawing, is such that during the compression and expansion periods the inlet and exhaust valve ports are hidden in the water-cooled cylinder head, shielding them from high temperatures. The sleeve valve itself has almost no sliding motion during its upper position, but its rotating motion is the greatest then.

Through the latter it is being shifted so as to bring its exhaust ports approximately in line over the exhaust openings of the cylinder as shown. The crank disk *a* operates the valve in this manner by means of a pin *b*, pivoted at the valve sleeve in *c*, and having a bearing *d* in the disk *a*. During the expansion period the sleeve valve starts downward, and in due time the exhaust ports of both sleeve and cylinder will register. At the lowest sleeve position again it will have the greatest rotative motion in the opposite direction, whereby the exhaust ports will be closed and the inlet will start to open. The inlet ports are closed by the continuing and increasing upward sleeve velocity, combined with slowing down of its rotation. The shape of the inlet valve opening curve will be irregular, viz., a quick straight line start, like that of a rotary valve, gradually acquiring the character more of a sinusoid curve.

Fig. 9 represents a French sleeve valve construction, which has been actually built and tried and is said to be successful. The valve *a* is split lengthwise in *b*, allowing it a slight spring to keep tight the cylinder inside. The inlet port *i* and the exhaust port *e* are located one above the other, at both sides of the place adjoining the split *b*. The valve is operated through a lever *d* with sliding blocks *g* on one end of it and a ball joint *f* on the other. The motion is transmitted from the crankshaft to a half-time shaft *c*, provided with a cam *m*, in which operates the bell crank *u*. This latter is also connected with a ball joint *k* to the lower end of the adjustable rod *p*, acting on the lever *d*.

The construction is very complicated, with many joints and other places subjected to wear. Though this wear can be taken up in some places, there are others bound to have lost motion. The valve openings can be made of a very favorable character by using the cam *m* of proper shape. However, the start and end of the opening have to be made more or less lingering; otherwise the sudden motion impulse will create great strains in the operating mechanism, which has a number of weak points.

Half-Sleeve-Valves

Another French construction makes provision for using two separate sliding valves—one for the inlet, the other for the exhaust, whereby each of these valves represents a half of a cylindrical sleeve valve, similar to that of the Knight motor. These half-sleeve valves work directly between the piston and the cylinder. The motor has separate half-time shafts for operating the valves, like the ordinary T type of poppet valve motors. The construction has a defect found also in the last previous one described, viz., the inside pressure upon the valve is not equalized, and a considerable force is required to overcome the friction between the valve and the cylinder wall. The latter construction is still worse in this respect, because with a decrease of gas pressure during the expansion stroke the valve surface exposed to this pressure increases.

In conclusion, the writer wishes to repeat his opinion that those valve systems which should and which will compete successfully with the poppet valve ought to be the least complicated mechanically. The combining of different valve systems with the intention to create an advantageous construction falls even in its avowed purpose. Moreover, in most cases the separate use of valve types, entering the combination system, ought to be better than the latter.

Some further development of the individual valve types has to be accomplished before employing of combination systems can be justified, even as a means of getting around some doubtful points of the former.

Electro Steel

IMPORTANT SUBJECT PRACTICALLY CONSIDERED BY JOSEPH SCHAEFFERS, MEMBER OF THE SOCIETY, POINTING OUT ITS CHARACTERISTICS FROM THE VIEWPOINT OF AN AUTOMOBILE ENGINEER

DURING the past few years electrically refined steel has been a matter of discussion in many industrial centers. If I venture, in spite of this, to lay before this meeting a consideration of the comparative merits of electrically refined steel, or, in short, electro steel, it is because a renewed consideration of the subject appears to be justified and demanded by the industry.

Though electric steel refining progressed slowly at first, it is now advancing with rapid strides and is being taken up readily by the entire industry. In spite of numerous publications concerning electro steel and the various systems of its manufacture, there is still a good deal that is obscure.

Although I assume that members are, from what has been published, well acquainted with the various types of furnaces, the following will give a brief summary of the types which are available at the present time. All those furnaces which have got no further than being patented and those which have been tested and found no further application may be passed over. Principally, the following remain to be considered: The Stassano, Héroult, Girod, Kjellin, Frick, Hiorth and the Röchling-Rodenhauser.

The Stassano furnace has three electrodes which form one or more arcs directly over the bath. The first Stassano furnace that proved acceptable to the iron industry was built in 1898. In order to effect a thorough mixing of the charge, particularly for alloy steels, the furnace is designed to rotate on an inclined plane. It is obvious that this design, as shown in Fig. 1, is not suited for large sizes. The loss of heat by radiation is excessive, the space required to rotate the furnace with the electrodes extending sideways is considerable, the electrodes are liable to break and the charge resulting from the furnace is not always uniform.

Although a number of the Stassano furnaces were operated successfully in the early part of the electro-steel period, most of them have been retired with the advent of more satisfactory systems.

In 1900 Héroult applied for a patent on his furnace, which is the best-known and most successful electro furnace of to-day. After having approached the leading American and European steel producers in vain, trying to induce them to take up his invention, Héroult met Lindenberg, then the owner of a small but well-known crucible steel plant in Germany. With Lindenberg's financial backing and under the direction of Richard Eichoff (Professor of Metallurgy at the Royal Academy of Mining in Berlin) two experimental furnaces of ½ and 1½ tons capacity were erected in 1905. On February 17, 1906, the first charge of commercially manufactured electro steel was poured at the Lindenberg Works, and since March 23, 1906, two furnaces have been in uninterrupted service.

In the Héroult furnace the arc is not formed between the carbons as in the Stassano furnace, but between the carbon and the bath of the metal, so that the current which passes through the

carbons also passes through the bath of metal (see Fig. 2). The construction of this furnace offers several advantages over the Stassano furnace. As the carbons are arranged vertically there is less chance of heating the roof, which is removable. The furnace does not need to be rotated and is more simple in construction.

The third arc furnace to be mentioned is the Girod furnace, in which one electrode is a suspended carbon and the other iron, placed at the bottom of the furnace and water cooled (see Fig. 3). A furnace closely resembling the Girod type had been constructed in 1878-79 by Werner Siemens, but without attaining any success. Girod, in using water-cooled electrodes, hopes to combine the advantages of the resistance furnace with those of the arc furnace. However, since the resistance of the carbon electrode in his furnace is several thousand times as large as the resistance of the bath, it can be figured easily that the heat caused by the resistance of the bath constitutes a negligible quantity. On the other hand, it is evident that in the Girod furnace there will be a gradual increase in temperature from the water-cooled bottom electrode to the active surface of the bath, and the metal which is solid near the electrode becomes pasty at first and then liquid as the distance from this electrode increases. In alloying the charge with elements of a very high melting point, like tungsten, with a specific weight several times as high as that of iron, this cold furnace bottom cannot be considered an advantage.

Suppose an alternating current is passed through a current of copper wire called the primary, and another coil be suitably placed near it, then a secondary current will be induced in this coil without the two coils of wire being in any way connected together. This property of an alternating electric current enables a comparatively small current in the primary winding to induce a very large current in the secondary winding with a very small loss of power, the currents being inversely proportional to the number of turns in the respective windings. This principle of induction enables as large a current as may be required to be produced in an ideal manner. Ferranti utilized this principle in the first instance by inducing currents in the body to be heated, and paved the way for all the modern electric furnaces of the induction type. He obtained in 1887 a British patent for his invention, which has not attained practical importance.

Fig. 4 shows an induction furnace having the principal points of the Kjellin furnaces. In this furnace the primary winding is placed within a cylinder made of refractory material, and either cooled by water circulation or forced draught. The annular hearth surrounds this cylinder and contains the metal, which is an electrical conductor and acts as a single-turn, secondary winding. If a current is passed through the primary winding, an exceptionally large current is induced in the metal in the hearth, which heats the metal, practically the total amount of electrical energy being converted into heat.

The construction of the Frick furnace (Fig. 5), which has also attained practical importance, is very similar to that of the Kjellin furnace. The principal difference between the Frick and the Kjellin furnaces is that in the former the primary windings are placed above and below the annular hearth instead of within it. The heat is produced in the same way in both furnaces.

The Röchling-Rodenhauser furnace, which has been patented since 1906, has a hearth of a very different shape from the induction furnaces previously described. This furnace is constructed for single-phase and for three-phase current, having two grooves in which metal is melted in the first case and three in the second. In both cases these two or three grooves or heating channels, each of which correspond to the annular hearth of one of the above-mentioned induction furnaces, open into a distinct open hearth, the working chamber, where all the metallurgical operations take place; the grooves, which have a comparatively small cross-section, form the secondary circuits in which the currents which heat the metal are induced (Fig. 6, single-phase Fig. 7, three-phase, design).

The author has spent considerable time in Europe this year studying the various methods of producing high-grade steel, as well as the different types of electro-furnaces. The members of the Fifth International Congress for Mining and Metallurgy, held this summer at Düsseldorf, Germany, were invited to visit various steel mills, among others

Steel Works, Rich. Lindenberg, A.G., with 2 Héroult-Lindenberg furnaces.

Steel Works, Becker, A.G., with 1 Girod furnace

Steel Works, Minkemoeller, with 1 Stassano furnace.

Through invitation of the iron and steel works, Röchling Bros., the author further inspected the two induction furnaces of the Röchling-Rodenhauser type at their Völkingen plant; likewise, the Krupp Steel Works, at Essen, where several types of electro-furnaces (Girod and Frick) are being tried out, and the steel works "Deutscher Kaiser," the works of August Thyssen, the German Carnegie, where three Héroult-Lindenberg furnaces, two of 7 tons each and one of 15 tons, are at work.

In nearly every instance I found the electro-process being carried on in conjunction with either the converter or the open hearth, the charge being melted and over-oxidized in either the converter or the open hearth and refined and deoxidized in the electro-furnace; steel of every description and for every purpose being made, structural rail steel, tool steel, armor plate, etc., the refining process always being carried just so far as is considered sufficient for the purpose.

For equal toughness electro steel can carry from .10 to .20 per cent. more carbon than crucible or open-hearth steel, possessing in consequence greater resistance to wear and tear, and allowing a reduction of sizes as proportionately shown in Fig. 8.

The rail specifications of the Royal Prussian railroads call for a certain deflection (3⅛ in.) at a given minimum tensile strength (100,000 lbs. per square inch). With Thomas steel four to five shocks cause this deflection at the tensile strength stated. Raising the tensile strength caused the steel to fail in the shock test. An electro-steel rail slightly higher in carbon and having a tensile strength of 124,000 lbs. per square inch, with otherwise identical chemical composition, took eight blows before the required deflection was reached, while breakage occurred only after the fifteenth blow.

Compared with crucible steel of identical chemical composition, electro steel possesses a greater density, complete absence of blow-holes, cracks and surface flaws, is less susceptible to the influence of copper and arsen, forges more readily and is able to withstand a higher heat. Electro steel can be made purer than crucible steel, and permits every alloy and chemical composition, like 4 to 5 per cent. silicon steel, 2 per cent. aluminum steel, etc.

The principal point of its superiority as compared with other makes of steel, however, and the one to which its high dynamic qualities have to be attributed, is not so much the low amount of impurities but the almost total absence of gases mixed and combined with the steel, principally nitrogen and oxygen.

As an expression of this superiority in actual figures the tabulation given on page 140 needs no further comment.

Motor Car Purposes

Having given an outline of electro steel as to manufacture and quality, a few words about its value for motor car purposes may not be out of place. In our present-day practice 3½ per cent. Nickel steel and Chrome Nickel steel seem to be the average material for cars that are expected to last more than one season, although cars made entirely from the lowest priced open-

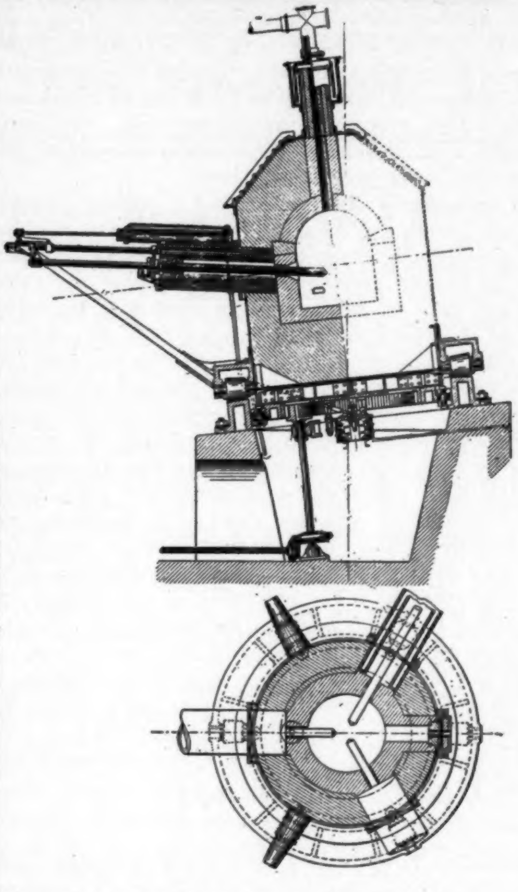


Fig. 1.—Stassano Electro Furnace with rotating device.

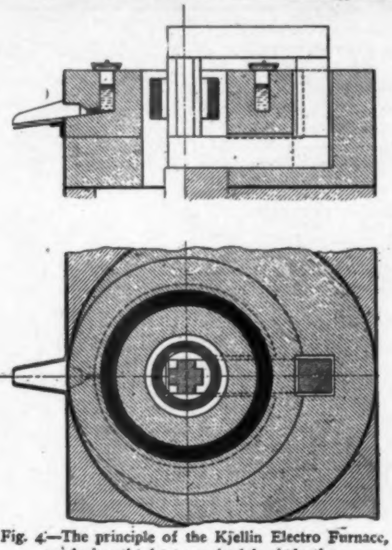


Fig. 4.—The principle of the Kjellin Electro Furnace, producing the heat required by induction.

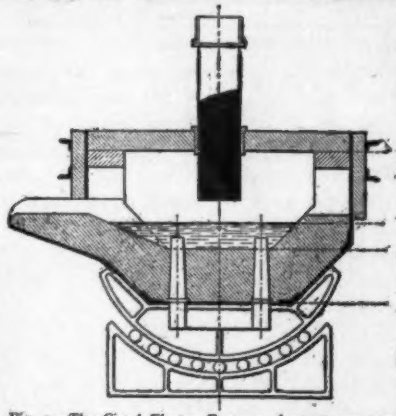


Fig. 3.—The Girod Electro Furnace, showing one carbon electrode on top and the iron electrode on the bottom.

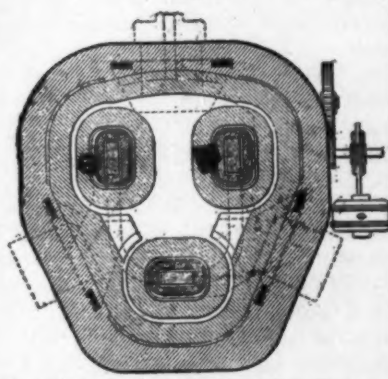


Fig. 7.—The Röchling-Rodenhauser Three-Phase Induction Furnace.

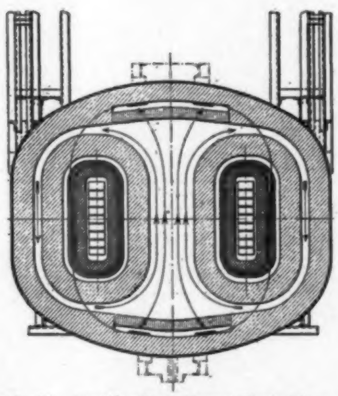


Fig. 6.—The Röchling-Rodenhauser Single-Phase Induction Furnace.

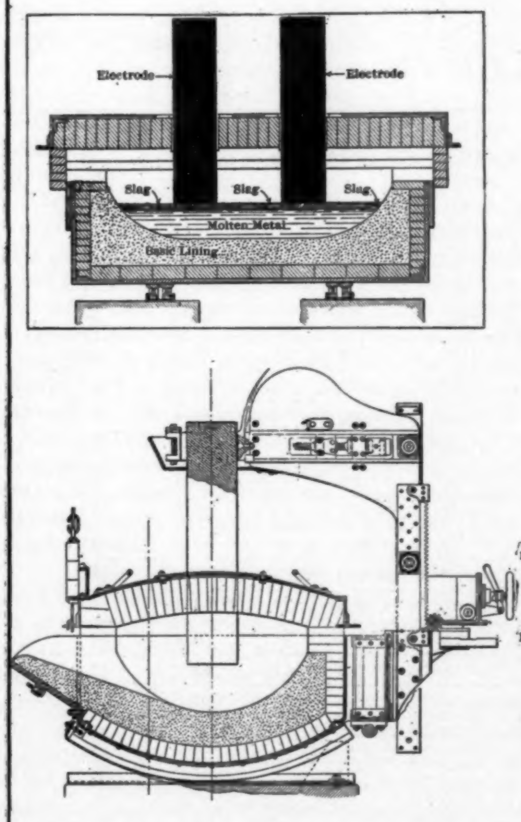


Fig. 2.—The Héroult-Lindenberg Electro Furnace in two sectional views, showing tilting device and carbon-electrode control.

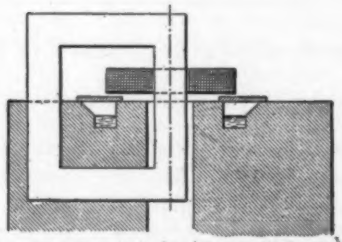


Fig. 5.—The Frick Induction Furnace, having the inductor parallel to the charge instead of concentric, as in the Kjellin Furnace.

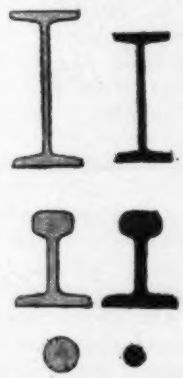


Fig. 8.—Electro Steel against Open-Hearth Steel. The cross-lined section represents open-hearth steel; the black section electro steel. The smaller section of electro steel having precisely the same dynamic value as the much larger section of open-hearth steel.

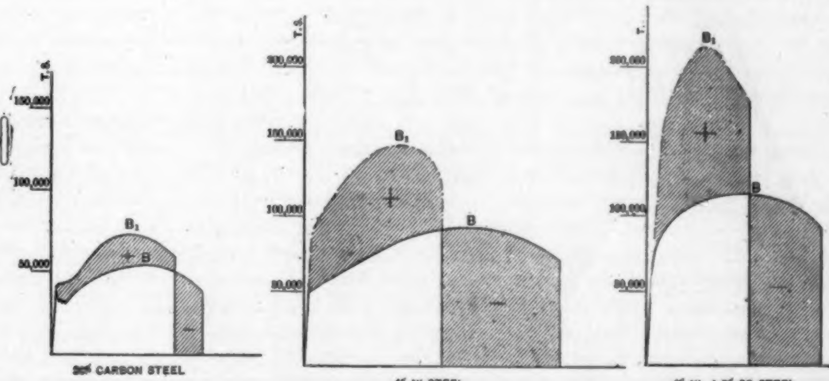


Fig. 9.—Showing comparative values of Carbon, Nickel and Chrome Nickel Steels. Curves "B" represent the annealed and curves "B1" the hardened condition.

hearth steel are abundant. It is not within the scope of this consideration to advise motor car designers what grade of steel they ought to specify for their products. The following table (Fig. 9) of comparative merits of carbon, nickel and chrome nickel steel may be, however, not entirely valueless. This table takes into consideration a 20 per cent. carbon steel, the same with 4 per cent. of nickel added, and with 4 per cent. of nickel and 1.5 per cent. of chromium added. The curves show the tensile strength in the annealed and in the hardened condition of these three qualities, the shaded section showing the gain in strength and the loss in contraction as caused by the heat treatment. Since a contraction of 20 to 25 per cent. is entirely sufficient and any excess beyond this figure does not materially increase the value of the steel, it may readily be seen from these curves which grade of steel should prove the greatest benefit for automobile purposes. The co-ordinate T.S. shows the tensile strength in pounds per square inch. These curves are based upon the grades of steel that can be had everywhere in the open market.

By taking electro steel as the base material for alloying with nickel and chromium, the values shown by these curves may easily be exceeded. One standard grade of electro chrome nickel steel as manufactured by the Lindenberg Mills has in the annealed state an elastic limit of more than 250,000 pounds per square inch, and is being used for motor car purposes, for gun shields, etc. This material, rolled into sheets 1/8 inch thick, annealed, withstood successfully a bombardment with the latest type of German army rifle at a distance of less than 250 yards, not a single bullet being able to pierce the sheets. Another grade of electro chrome nickel steel from the same mill and extensively used for gears, etc., has a tensile strength of 185,000 and an elastic limit of 180,000 lbs. per square inch, which are raised by proper heat-treatment to 285,000 lbs. tensile strength and 280,000 lbs. elastic limit, the incidental reduction of area being about 30 per cent.

Comparing these figures with the nickel and chrome nickel steels used in considerable quantities by American automobile makers, and showing in the annealed state a tensile strength of about 100,000 lbs. and an elastic limit of from 60,000 to 70,000 lbs. per square inch, the great difference between tensile strength against elastic limit is at once apparent. While in high-grade electro chrome nickel steel less than 3 per cent., this same difference amounts to more than 30 per cent. in most of the steels that are used at the present over here.

It has to be remembered that the value of a steel is indicated by its elastic limit, while the resistance it offers against machining is plainly given by the tensile strength. In the one case then the expenses for tooling parts correspond closely to the value they are going to have in the car; in the other case for every 100 per cent. of machining expenses only about 70 per cent. of value is returned. Moreover, though it is needless to again emphasize the fact that electro steel has more strength and endurance, it has to be remembered that a considerably smaller quantity will suffice for a given purpose. The saving in the amount of steel required more than compensates for the difference in price, if there is any. The resulting dimensions of parts, however, decrease the amount, time and expense of machining, increase the productive ability of tools and machines, lower the share of overhead charges per work-unit and, finally, reduce the weight of the finished car. The purchaser of the car has the benefit of a higher factor of safety, a lightweight car, low tire and gasoline expenses, small repair bills and last, but not least, of a car that will last him several times as long as one made of a lower grade of steel. The manufacturer, then, saves money in numerous different ways by choosing the best grade of steel conforming to his requirements, and ultimately his customers will be satisfied and be his best advertisers.

Solidified Gasoline Invention—Consul Albert Halstead sends from Birmingham a press description of a chemist's invention for converting gasoline or petrol into a stiff, white jelly. It is effected by adding 1 3-4 per cent. of steatite and alcohol. A high-powered automobile recently made long trips in England successfully using the new jelly, for which the inventor claims an economy of 30 per cent.

COMPARATIVE TESTS MADE WITH STEEL FROM THE OPEN MARKET BY L. GUILLET, PARIS

GRADE OF STEEL			CHEMICAL COMPOSITION					TENSION TESTS				DROP TEST
			C.	Mn.	Si.	S.	P.	T.S.	E.L.	El.	Con.	Number of Blows
								Lbs. per sq. in.		In %		
1.	Electro	All test-pieces quenched uniformly at 875°C.	.051	.184	.047	.024	.011	53 000	36,000	34	71.5	50
	Open-Hearth		.062	.325	.095	.018	.021	50,000	30,000	29	54.3	23
	Crucible		.050	.250	.178	.023	.015	52,000	35,000	30.5	50.0	22
2.	Electro		.136	.297	.070	.007	.016	58,000	33,000	34	69.0	48
	Open-Hearth		.042	.330	.055	.052	.023	56,000	32,000	27	48.2	24
	Crucible		.139	.225	.125	.028	.010	57,000	33,000	29	52.4	25
3.	Electro		.220	.399	.070	.008	.007	69,000	40,000	27.5	56.5	25
	Open-Hearth		.205	.445	.152	.062	.091	67,000	37,000	26	43.6	20
	Crucible		.230	.327	.180	.030	.020	58,000	36,000	27	48.9	23
4.	Electro		.218	.385	.360	.012	.017	72,000	47,000	27	61.7	28
	Open-Hearth		.205	.445	.152	.062	.001	68,000	37,000	26	43.6	20
	Crucible		.230	.327	.180	.030	.020	66,000	36,000	27	48.9	23
Average	Electro		—	—	—	.013	.013	63,000	39,000	30.6	67.7	38
	Open-Hearth		—	—	—	.048	.034	60,000	34,000	27.5	47.4	22
	Crucible		—	—	—	.028	.016	59,000	35,000	28.4	50.0	23

S. A. E.

Fire Protection

N. B. POPE DISCUSSES REASONS FOR AUTOMOBILE FIRES AND METHODS OF ENGINEERING BY WHICH THEY MAY BE PREVENTED

THAT there is a certain amount of fire risk attendant upon the storage and operation of cars is a fact that most automobile men, accustomed to taking proper precautions, are perhaps too much inclined to make light of.

By reason of the fact that it uses a highly inflammable form of liquid fuel, the gasoline automobile commonly is saddled with a greater nominal risk than is rightfully its own. To remove this impression would be a profitable undertaking in many ways; it would strengthen the confidence of the public in the motor vehicle; it would be of material benefit in convincing the manufacturer and merchant of the advantages of motor transportation as an adjunct to his business, and it would eventually eliminate unjust discrimination between this and other transportation mediums.

The average modern, well-equipped garage is so constructed, arranged and outfitted as to be as safe, relatively speaking, as could be desired. Unfortunately this is not true of the average garage the country round. Many such establishments have been converted from other uses, many have been built hastily and without due regard to certain definite precautions that should be embodied in every garage that may properly be called safe. With such establishments the engineer who is in any way in touch with installation and operation work may well concern himself. It is unquestionable that many of them are positively dangerous, not only as pecuniary risks, but in material degree as a menace to the reputation of the industry.

The principles of safety in garage construction include the imperative need of fireproof building construction, constant and effective ventilation of all floors, thorough drainage embodying well-ventilated settling chambers to prevent the accumulation of volatile oils and inflammable vapors in sewers, isolated heating plants, isolated storerooms for inflammable supplies, underground fuel tanks, and, wherever possible, provision for dispensing fuel and oils in the open air or at least in an isolated court or passage which is subject to thorough ventilation at or about the ground line.

The garage risk is twofold. It involves the possible risk arising from the storage and handling of large quantities of oil. It also involves a certain amount of risk due to the housing of a large or small number of cars, each of which may be considered in itself a risk. In an ill-ventilated garage a spark from the unprotected controller of an electric car, the arcing of a switch at a charging board, a stray spark from the ignition system of a gasoline car, a back-fire or a muffler explosion may cause a fire through the ignition of stagnant gasoline vapor or gas.

The problem of fire risk as involving the individual machine may be considered under two general headings: first, the power plant, and, second, the general vehicle structure. Under the first heading electric and gasoline equipments may be discussed independently.

Considering, then, the power element of the electric vehicle, it is apparent that there are but two possible sources of risk, namely, the electric spark and the overheated wire. Sparks may occur at the controller, at the motor or from crossed wires or short-circuits caused by disarrangement of the wiring or connections. The liability of burn-outs, either in the motor or in the connections, is small, though burned-out motors are by no means unknown to electric vehicle history.

All controller and motor mechanisms should be iron-clad and the controller, at least, asbestos-lagged if its construction is such as to render it at all liable to arcing at the contacts. All conductors, whether on battery, motor or bell and lighting circuits, should be thoroughly protected against chafing and disarrangement and all outside connections should be protected in suitable junction boxes.

In the case of the gasoline machine the risk is more involved, first, because the power plant itself contains greater elements of danger, and, second, because the presence of considerable quantities of gasoline and oil increases the liability of a fire spreading, regardless of its origin. The gasoline car risk may be divided into primary and secondary elements. Considered in order the elements of direct risk are: Fuel tank, fuel piping, carbureter, exhaust piping and muffler.

Secondary elements of risk or those which in conjunction with one or more of the direct elements may lead to a fire in the car itself are: Ignition system, general arrangement.

Just as "crossed wires" are blamed for a majority of building fires of otherwise unexplained origin, so "explosion of gasoline" is the cause assigned to most automobile fires. But the automobile engineer must seek further in order to arrive at a proper means of preventing loss. There is no question that the air inlet to gravity tanks should be protected by a gauze screen as a means of preventing the ignition of the free gas within the tank, while pressure tanks might be provided with a blow-out plug mounted over a screened orifice as a means of preventing an explosion and providing an outlet for the fuel vapor during a fire. As a special means of precaution it is possible to conceive of an emergency shut-off for the carbureter feed pipe, spring-actuated and ordinarily held open by a plug of fusible metal. Such an arrangement could be so constructed that it would close the gasoline line automatically should the contents of the carbureter take fire. With suitable measures to prevent carbureter fires, however, this would seem uncalled for. But it is particularly important that the regular gasoline shut-off from the tank be so located that it may be reached in an emergency without difficulty or delay.

Combined with the occasional tendency to back-fire, probably the greatest source of danger in the average carbureter is leakage arising from improper adjustment. As this cannot be forestalled by the designer, the only thing left for him to do is to provide a separate drip for the carbureter outside the sod pan.

The exhaust side of the motor is commonly regarded as being free from danger in respect to fires, but it is not absolutely so.

The ignition system has been mentioned as a secondary element of risk. It becomes so only when so constituted that a stray spark at the timer may serve to ignite inflammable vapors which may have collected under an improperly ventilated hood.

As far as lubrication is concerned it may be considered that the presence of waste oil in the sod pan, on the outside of the cylinders and crankcase and on the interior of the engine compartment, adds to the risk, though not tending to incite conflagration.

One other question which arises in this connection is that of illumination. It is commonly considered that no great risk is involved, even in the use of kerosene lamps, and probably the only instances in which the lamps have been in any way concerned with the starting of automobile fires have been in cases where a detached lamp has been used as a searchlight by some short-sighted Diogenes of the car in search of an honest leak. It is beyond question, however, that the more general adoption of electric lighting on cars, even on those of the commercial type, will be of assistance in reducing the nominal risk of fire.

S. A. E.

Automobile Road Building

LOGAN WALLER PAGE, DIRECTOR OF PUBLIC ROADS, UNITED STATES DEPARTMENT OF AGRICULTURE, TELLS OF METHODS, CONDITIONS AND WEAR

BEFORE discussing the construction of automobile roads it may not be amiss to consider briefly the action of automobile traffic on roads as compared with horse-drawn traffic. Under horse-drawn traffic a well constructed macadam road wears out in two ways: (1) by actual wear of the road material due to impact and abrasion of iron shoes and iron-tired wheels, and (2) by disintegration of the road surface apart from the wear of the road material. The first form of wear actually reduces the second by constantly forming new binding material to replace that which is removed. Where a suitable road stone is employed, this replacement keeps abreast with the removal of the products of wear and the road wears out slowly and uniformly. The cost of maintenance is therefore kept within economical limits. On macadam roads, and, in fact, on any type of road, the rubber-tired automobile causes but little wear of the material of which the road is constructed. Unless, however, the individual fragments or units of which the road is composed are firmly held in place, the powerful shearing action of the driving wheels displaces these fragments and so causes rapid disintegration of the road surface. This action increases with the speed and weight of the vehicle, and is most pronounced on curves, owing to skidding of the machine at such places. The use of chains and other anti-skidding devices hastens somewhat the wear of the road material.

In the construction of automobile roads there may be one of three conditions to meet:

(1) The road may be subjected to automobile traffic only, in which case excessive speed is often encountered. Speedways and race tracks are examples of such roads.

(2) The road may be subjected to moderate automobile traffic and light horse-drawn traffic as in the case of parkways and pleasure drives.

(3) The road may be subjected to mixed traffic, including automobiles and heavy horse-drawn or teaming traffic as in the case of many of our country and suburban highways.

While each of these conditions can be successfully met by different forms of construction, there are certain fundamental principles which should never be lost sight of in attempting to meet them. For instance, in roads subjected to horse-drawn traffic a certain degree of resiliency is highly desirable, while in those subjected to automobile traffic only, resiliency is a minor consideration, owing to the cushioning effect of the rubber tires. Therefore, an automobile speedway or race track may well be constructed of some rigid material, such as Portland cement, concrete or brick. Roads constructed of such materials are particularly well adapted to withstand the shearing action of machines driven at high speed, for the individual parts are held rigidly in place by a powerful chemical set in the case of cement concrete and by a mechanical set in the case of bricks or blocks. If such roads are well constructed and properly banked at curves, they should be practically unaffected by automobile traffic and if well crowned and drained should last indefinitely, providing due precautions are taken to prevent expansion or contraction cracks, by placing expansion joints where needed. Macadam or gravel roads surfaced with a good grade of bituminous binder may give temporary satisfaction for this class of traffic, but it is doubtful if either the bituminous surfaced or bituminous constructed road will eventually prove as economical, owing to the necessity for more frequent treatment or repairs. In this connection, it will be of interest to compare the cost of the brick-paved track at Indianapolis with other large automobile race courses during a period of five or ten years.

The very factors that make cement concrete, brick and blocks desirable materials for the construction of strictly automobile roads cause them to be far from ideal materials for the construction of roads subjected to mixed traffic. Brick and cement concrete, being non-resilient, are hard upon horses and make noisy roads under the impact of iron-shod hoofs. Such roads are therefore undesirable for parkways and pleasure drives. Besides this, all types of brick and block pavements are at the present time far too expensive for the average park and pleasure drive. Surface treated macadam and gravel roads are, as a rule, well adapted for the class of traffic here encountered, providing a suitable binder is intelligently applied. The roads are, as a rule, under constant supervision, so that it is possible to make a number of applications of the binder during a season, if necessary, without exceeding economical limits. The materials used in such treatment may be hygroscopic salts, oil emulsions or more or less fluid bituminous binders, according to specific local conditions which will have to be met.

Hygroscopic salts, oil emulsions and very fluid oils and tars are employed mainly for the purpose of laying dust, but in so doing they protect the road to a great extent from the destructive action of motor vehicles. As long as the finer products of wear are retained upon the road in sufficient quantity to bind the coarse mineral fragments together, the automobile can do but little damage. As soon, however, as these materials lose their dust-laying effect or are removed from the road, the destructive action begins and if not quickly checked will cause rapid disintegration of the road. For this reason it is necessary that the treatment be made under competent supervision and at just the right time in order to secure economical results.

Hygroscopic salts, such as calcium chloride, are usually applied in solution and serve to intensify the dust-laying effect of water. Oil emulsions, while applied by means of water which acts as a carrier, serve as dust layers after the water has evaporated. Certain types are, however, essentially greasy and exhibit no binding value. This may also be true of the light petroleum and tar products, and when such is the case more harm than good may ultimately result from their use, for by surrounding the mineral particles with a film of grease they act as lubricants and gradually break up the already existing bond of the rock dust. If they are not applied in excessive quantity, a season or more may elapse before their injurious effect is noticeable, and then the road will begin to ravel and disintegrate, although more than sufficient fine material may be present to serve as a binder under normal conditions. When this happens, little can be done except to build a new road, for it is almost impossible to rebond the lubricated fragments even by the application of a good binding material. In the surface treatment of roads with oil or tar products, it is poor policy to make use of a material even for dust laying, which will not also serve as a binder. Non-realization of this fact has undoubtedly been responsible for the failure of many surface treated roads.

Besides the temporary binders or dust palliatives above mentioned, good results have been obtained in the treatment of parkways with refined oil and tar products heavy enough to require heating before they can be applied. Such materials, if

containing a good binding base, form a mat or carpet over the surface as they become incorporated with the dressing of stone chips, sand or gravel, which is given the road after their application. This mat takes up a considerable amount of wear, and at the same time protects the underlying surface from disintegration. Until the point of saturation of the bitumen for dust has been reached, the road will be practically dustless. This method of treatment should prove effective for at least one year to be economical. In some instances the effect is of longer duration, depending largely upon weather conditions and character of traffic which the road receives.

Horse-drawn traffic is more destructive to these mats or carpets than automobiles, particularly in rainy weather. If, however, it is confined to light carriages and buggies and the proportion of these vehicles to automobiles is small, they do but little permanent damage. In such instances the passage of a large number of automobiles iron out the marks of hoofs and the grooves cut by steel-tired wheels almost as fast as they are formed.

Before leaving the subject of surface treatment, mention should be made of one other surfacing material which acts as a powerful temporary binder. This material is the concentrated waste liquor obtained from sulphite process wood pulp mills. It is soluble or miscible in all proportions with water and is applied by means of an ordinary sprinkling cart. It is particularly well adapted for use on automobile roads, and produces a hard, well bound surface, providing all excess of dust is removed before it is applied.

The economical construction and maintenance of the type of road which is subjected to mixed automobile and heavy teaming traffic is probably the most difficult and important problem that to-day confronts the road engineer. As previously stated, this type covers many of our country and suburban highways. Frequent application of surface binders under most circumstances cannot be considered even if such treatment would prove satisfactory, for the reason that these roads are not under the constant supervision given to park and pleasure drives. Surface application of the heavier bituminous binders has not proved satisfactory where teaming traffic is heavy, owing to the fact that the heavily loaded and comparatively narrow steel-tired wheels cut through the bituminous mat in wet weather, and soon cause disintegration. The action of iron-shod horses' hoofs is also more severe than on pleasure drives, owing to the heavier loads which are hauled over the road. For the preservation of existing roads, surface treatment may be resorted to, but when the road is sufficiently worn out to require resurfacing or when a new road is to be constructed, it is far better policy to incorporate a binder in the road during construction or reconstruction.

Brick and block pavements are, as a rule, too expensive for this kind of road, and the non-resilient types are undesirable for reasons before mentioned. Where excessively heavy teaming traffic is encountered, the inconvenience of the noisy brick and cement pavement may be more than offset by their lasting quality, but under ordinary conditions the bituminous constructed macadam road will be found most satisfactory. In the construction of bituminous macadam roads it is seldom necessary to incorporate the binder with more than the upper two or three inches of stone constituting what is known as the wearing course. This is usually done in one of two ways, known as the penetration method and the mixing method.

The penetration method seems to be the more popular to-day, although good results are not as assured as in the mixing method. For both it is, of course, absolutely essential that a good grade of bituminous binder be used, and failure to obtain such a binder has undoubtedly been the cause of many unsatisfactory experiments along this line. For the penetration method semi-solid petroleum, asphalt and tar products or viscous fluid cut-back preparations may be employed, and certain modifications of the general method will often be required to meet the character and consistency of the binder. The same is true of the mixing method.

For a road six or eight inches thick, the foundation is prepared in exactly the same way, irrespective of the method which is later to be employed. All but the upper two or three inches is built as in ordinary macadam construction, with the exception that the voids are somewhat more carefully filled with fine stone screenings. This course may or may not be puddled with water according to circumstances, but in any event no surplus of screenings should remain on the surface to interfere with a proper interlocking of the foundation and wearing course.

In the penetration method a wearing course of broken stone, ranging in size from one-half inch to about one and one-quarter inches is laid upon the prepared foundation to a depth of approximately three inches and rolled until the stones interlock. The bitumen, heated to a considerable degree of fluidity, is then poured or sprinkled over the surface at the rate of from one to one and one-half gallons per square yard. This should penetrate the wearing course and completely cover it for a depth of at least two inches. Clean stone chips are next applied in sufficient quantity to fill the surface voids and prevent the binder from sticking to the roller wheels, and the road is then well rolled. A seal or flush coat of hot bitumen is painted on the surface at the rate of from 0.3 to 0.5 gallon per square yard, after which sufficient stone screenings are applied to take up all excess of bitumen.

In the mixing method the wearing course which is usually laid to a finished depth of two or two and one-half inches is composed of a more or less carefully graded mineral aggregate which has been previously mixed or coated with a hot bituminous binder. After being rolled this course is painted with bitumen and finished off in the same manner as described under the penetration method.

One other type of automobile road which is now being studied under my supervision, and which has so far given some promise of success, is Portland cement concrete, to which has been added during the mixing process from ten to fifteen per cent of residual petroleum upon the basis of cement used. This road, when painted with a coat of bitumen and covered with a thin layer of sand or stone screenings, seems to possess a number of advantages lacking in the straight cement concrete roadway.

Paris to Be Sanitary

Recognizing the Horse as Unsanitary, the City of Paris, in France, Goes Over to the Automobile

THE horse will have to go from the Street Sweeping Department of the city of Paris. He is too slow for work in crowded cities, and as time is money he has become too costly. The Street Sweeping Department has had in use for some time a number of rotary sweepers driven by a small four-cylinder motor, and have now taken delivery of a series produced for them by the Renault Co. Here the motor is a small two-cylinder, similar to the one employed extensively in Paris for taxicab work. The motor part is entirely on standard lines, the only difference forward being that large diameter metal-shod wheels are employed. At the rear the frame members are strongly upswept, very large diameter wood wheels being employed. Suspension at the rear is secured by means of a transverse inverted semi-elliptic spring. Drive is taken to the rear axle through a three-speed gear box, the gears being operated by the usual type of side lever, while a separate central lever serves to put into gear the shaft driving the rotary brush.

"Motor Under Seat" Truck

ADVANTAGES OF THIS CHARACTERISTIC OF CONSTRUCTION CONSIDERED COMPARATIVELY BY B. D. GRAY, MEMBER OF THE SOCIETY, AS AGAINST "FRONT TYPE"

THE "raison d'etre" of the commercial motor vehicle as compared with the horse-drawn vehicle, is one of efficiency and economy; efficiency in rapid, safe, and reliable transportation of goods, and economy in the net cost of obtaining the desired result.

For straight-away going in the open country, or in towns where the streets are wide and traffic is not congested, the general design of a truck makes little difference, except for the advantage to be derived from a nearly even distribution of the load on the front and rear axles, in decreased tractive effort on soft roads and less tendency to side-slip on hard slippery pavements.

It is necessary to have slightly more than half the total load on the driving-wheels to secure the necessary traction, the most desirable proportion being about three to two.

The nearly even distribution of the load possesses further advantages in relieving the rear springs, axles, wheels, bearings and tires of some of the inherent side-thrust, and effecting a slight saving in the cost of maintenance, particularly on the tires and bearings.

In narrow streets and in congested traffic the shorter vehicle with its shorter wheel-base permits much greater facility in driving, not only in threading its way through traffic, but in turning corners, driving in narrow streets, backing up to a platform, and in occupying considerably less space when backed up to a platform, or standing crosswise in a street.

In considering economy one must take into account in addition to the actual cost of operation, the space required for storing vehicles, and for loading and unloading. A 25 per cent to 30 per cent increase in the overall length of the vehicle for say a 12-foot loading space necessitated by the "motor in front" type, is a serious disadvantage from this standpoint. It means that for storage room alone 25 to 30 per cent greater space must be provided for the longer vehicle, to say nothing of the extra free space required for manipulating it in the garage, and the extra length of elevator required where the vehicle has to be lowered into the basement to be washed, and then taken up to one of the upper stories to be stored for the night, as is usually the case in large cities.

Perhaps the only plausible reason to be advanced for the "motor in front" type of commercial vehicle is accessibility, but in practice this amounts to nothing, because in modern construction the motor under the foot boards is quite as accessible for all ordinary care and adjustments, as when placed in front under a bonnet; and when it becomes necessary to remove the motor for a general overhauling, neither type possesses an advantage over the other.

It may be claimed that the shorter vehicle, with the greater load on the front axle is difficult to steer, but experience proves that it may be so constructed as to steer quite as easily as may be desired.

In summing up the advantages possessed by the "motor under the seat" type, the following may be mentioned:

Less overall length for a given length of loading space.

Shorter wheel-base for a given length of loading space.

Less weight.

Greater facility in handling in congested traffic and narrow streets.

Less power required.

Lower cost of maintenance, in fuel, tires and bearings.

Less storage space required.

Less space required at loading platforms.

Less space required in street, whether vehicle is moving or standing.

Don't annoy the accommodating salesman by asking him all about the things he is placed to watch; why should he know all the answers to your curious questions?

Don't take the demonstrator at his word; if he states that the live rear axle is of the floating type, why pull the jack-shaft out of its lodging place just to see if what he says is true?

Don't ramble around the arena day after day, gazing at beauty on legs and wheels and become so confused that you would not know a good automobile if you met it face to face—make a business of it; find what you want and tell the maker's representative to send it around to your house.

Magneto Ignition Practices

DISCUSSING AND ILLUSTRATING MAGNETOS AS THEY ARE EMPLOYED IN AUTOMOBILE MOTOR IGNITION WORK, STATING THE LIMITATIONS AND DEPICTING THE TREND

IGNITION work is being done by magnetos under running conditions to almost the entire exclusion of other forms of ignition equipment, it being the case that out of 462 models of cars which are being exhibited at the Garden 430 of them are equipped with high-tension magnetos, 13 with low-tension magnetos and the balance with special forms of equipment which are intended to compete with magnetos. The auxiliary ignition which is provided in nearly all the models of cars makes room for the ample use of coils of the various types and batteries, with about an equal distribution between dry and storage types. Confining the subject for the time being to the magneto phase of ignition work it remains to recount its virtues and state its limitations so that intending purchasers of automobiles will be fortified against misconceptions and will be in a position to act with deliberation.

If it may be taken for granted that the average automobilist is familiar with the general principles of ignition work, the discussion here can be confined to a few of the most material points, and the chances of confusion will be minimized. At all events the problem of efficient ignition demands that considera-

Magnetos

tion be given to the thermic relations of the motors in each case, remembering that a magneto that might be entirely satisfactory on a high-speed, high-compression, four-cycle racing automobile might fail utterly to satisfy the needs of the occasion when applied to a two-cycle motor as used in normal touring work. It should be well understood that in applying a spark to the mixture in the cylinder of a motor it is necessary to deliver one of sufficient energy for the purpose, in addition to which the temperature should be as high as possible, but with these factors, even though they may be adequately represented, there is ample room for failure, provided the timing of the spark is ill contrived, or if the mixture is over-rich or lean or the compression is improperly regulated.

It has recently been discovered that motors which are adjusted for efficient operation in England, using gasoline, so-called, as it is available there, when they are imported into the United States fail to work satisfactorily, thus indicating that the gasoline used in England differs in some important particulars from the gasoline which is placed at the disposal of automobilists in this country, and this point is a sufficient illustration of the fact that good ignition work has for its foundation the proper adjustment of the mixture as it comes from the carbureter, and this latter consideration is only possible if the carbureter is so designed that it will take the gasoline that is to be had and deliver a mixture that is rightly proportioned in the ratio of the air to the gasoline present.

In the early days of the automobile in America, when true gasoline was a drug on the market, the ignition problem was solved in a very simple way, and the efficiency of the ignition equipment did not have to be on the high plane that is demanded of it to-day. When hexane was delivered for the most part, it being extremely volatile, the mixture was easily ignited, even though the ratio of air to gasoline may have been poorly adjusted. In these days, when instead of gasoline a product called automobile gasoline is used, it being composed of a series of the "fractions" in the hydrocarbon series, few of which are sufficiently volatile to ignite readily, the ignition problem is rendered far more complex, so that instead of an indifferent coil ignition system it is necessary to employ a magneto or its equivalent, and the demand is even pressing for relatively well-designed magnetos, rather than those of an indifferent character.

It is even important that the compression be adjusted in view of the lack of volatility of a large proportion of the liquid of which the so-called gasoline is composed. This point may be adequately portrayed by calling attention to the fact that alcohol as a fuel cannot be utilized efficiently unless the compression in the motor is substantially 150 pounds per square inch. It is for this reason that the average motor, which is designed to utilize gasoline as the fuel, while it will run if alcohol is substituted therefor, is wasteful of the alcohol, and the results obtainable are not in good comparison with those which may be realized when gasoline is burned under fitting conditions.

But if it does require this high compression to burn alcohol efficiently it is also true that the compression which should be available when gasoline is employed as the fuel should be regulated in view of the quality of the gasoline. As the volatility

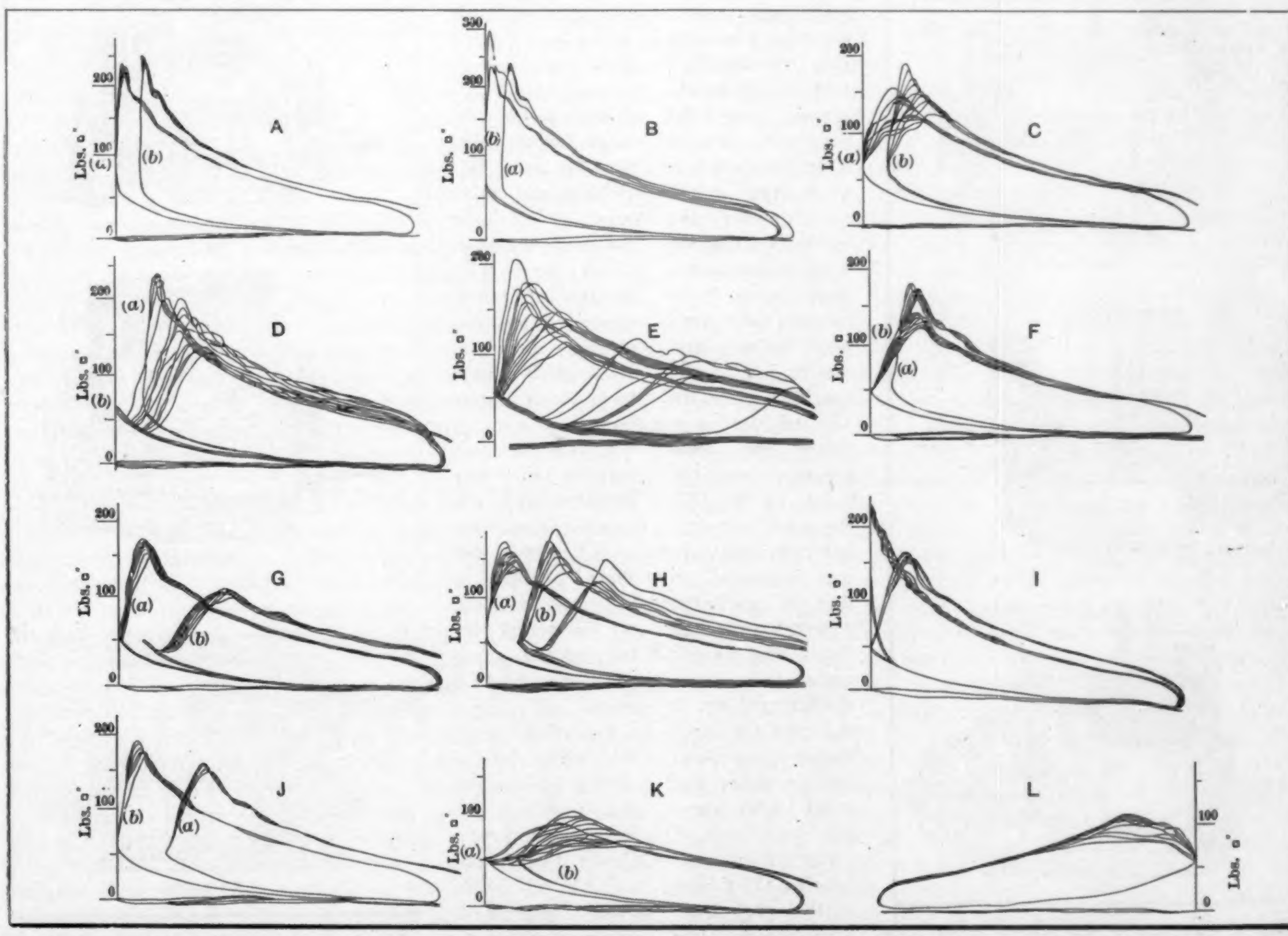


Fig. 1—A series of indicator cards showing the variations of results due to alterations in the timing of the spark and the use of gasoline of varying degrees of mixture with the air

of the liquid is reduced, the compression must be increased accordingly, it being the case that the rate of flame travel in the body of the mixture increases with the compression. It is extremely important that the rate of flame travel be considered, due to the fact that the thermal efficiency of a motor will be relatively low if the mixture continues to burn after the piston starts on its downward migration under the impetus of the energy which is being given off by the burning gases. Referring to Fig. 1 of manograph cards, which were taken to show the effects of varying ignition, it will be observed that A shows the result under two conditions of ignition in which (a) represents an early and moderately good spark resulting in a maximum pressure of 240 pounds per square inch, but the result with a somewhat later spark, as shown by B, affords a pressure of about 255 pounds per square inch, and the area traced by the manograph is somewhat greater, thus indicating that the timing of the spark has much to do with the result. Referring to B the conditions were better in that the mixture was adjusted with greater care and the spark was more efficacious so that with a late spark as shown at (a) the pressure ran up to 240 pounds per square inch, but with a well regulated spark as shown at (b) the pressure approximated 300 pounds per square inch, and the area traced by the manograph was the maximum obtainable. With a properly regulated mixture and a compression of about 68 pounds per square inch (gauge) it was possible to obtain the greatest amount of power from this particular motor, and the thermal efficiency was also at its highest point, so that fuel economy was well represented. Transferring the attention to C it will be observed that the card (a) was a miserable affair from the power point of view, due to the fact that the compression was a little low; the mixture was very poor indeed, and the timing of the spark was late. In (b) of the same figure the compression was the same as in (a), the spark was late, but the mixture was improved so that the maximum pressure reached 190 pounds per square inch. Continuing on to D the manograph traced a considerable number of cards under varying conditions of compression, and altering the timing of the spark from a relatively late position to still later positions. The best explosion pressure was 235 pounds per square inch, but as the spark was retarded and the compression lowered the explosion pressure receded, reaching its minimum level of 110 pounds per square inch. At E the manograph traced a considerable number of cards, superimposing them, and the highest explosion pressure was 205 pounds per square inch, with a compression of 85 pounds per square inch, and the timing quite well regulated. Changes in the character of the mixture, maintaining a constant compression, resulted in a slowing down of the rate of flame travel, so that finally the gasoline continued to burn throughout the power stroke, and the amount of power actually delivered by the motor ultimately reduced to a point where it was barely sufficient to turn the motor over, without doing any useful work at all. In this case it is plain to be seen that the thermal efficiency varied with the character of the mixture, and a good spark delivered at the proper time failed to compensate for the ills that come with a slow-burning mixture. It will be remembered, of course, that a mixture may be slow-burning (a) if it is over-rich, (b) if it is lean and (c) if the fuel is lacking in volatility.

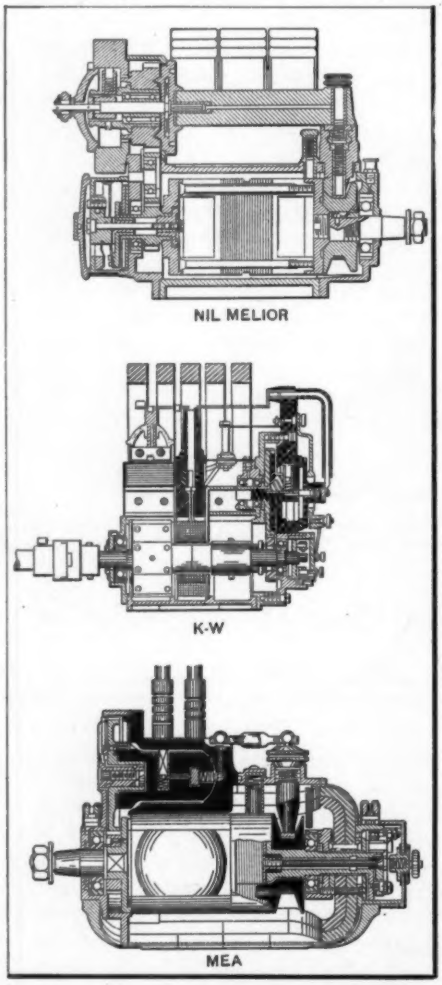


Fig. 2—Sections of Nil Melior, K-W, and Mea magnetos, showing design characteristics of each

Transferring the attention to F in the figure, the effect of relatively low compression, a poorly adjusted mixture and a retarded spark is miserably poor in (b) and somewhat improved in (a). Still another condition obtains at G in which the card as traced in (a) shows good timing, but poor mixture, and with a much retarded spark as shown at (b), considering the same mixture, the power fell away enormously. In H the card (a) is well timed and the compression is nearly high enough to do good work, but the mixture was lean. Enriching the mixture, maintaining the same compression, brought about a better condition of the explosion pressure, although it would have been much improved were it not for the fact that the spark was retarded and the superimposed lines as indicated in this chart showed a continual falling off in actual result as the spark was retarded more.

Referring to I, the effect of a much advanced and a much retarded spark is shown. With the spark advanced, the compression pressure ran up to 235 pounds per

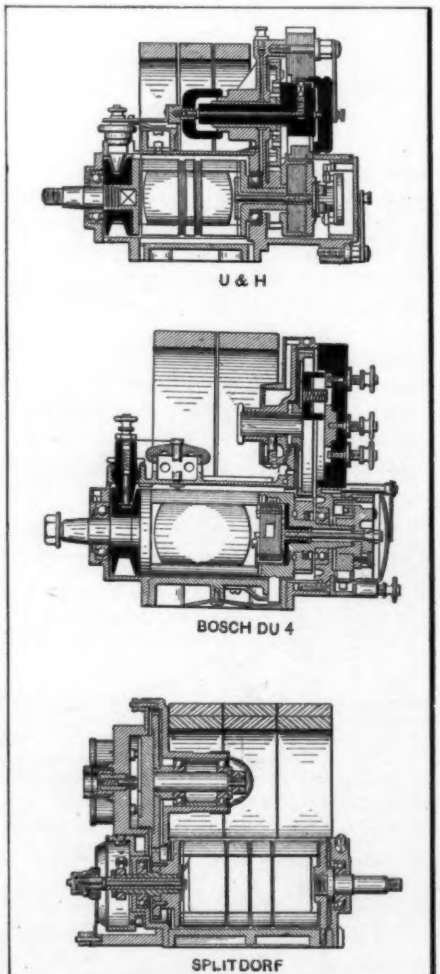


Fig. 3—Sections of U & H, Bosch DU4, and Splitdorf magnetos, depicting the design-plan of each

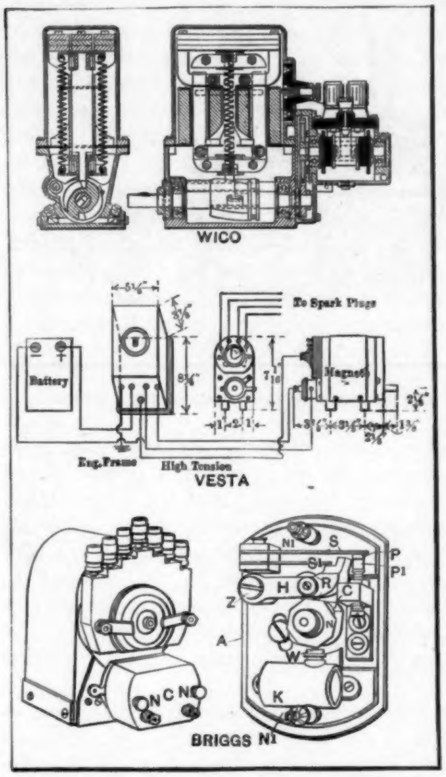


Fig. 4—Briggs magneto, showing details of design and the method of wiring up

square inch, but a considerable amount of the energy which was taken from the burning mixture was dissipated during the compression stroke, owing to the increasing of the compression due to the burning of the mixture simultaneously with the compression work. When the spark was much retarded, the explosion pressure fell off to 260 pounds per square inch, but the area traced by the manograph was considerably increased and on the whole the result obtained was somewhat improved, although the compression was too low to assure the best result, as shown at B. Referring to J, the chart (a) shows low compression, a much retarded spark and a poor result which was aggravated on account of the over-rich mixture used, and properly timing the spark brought about the curve, as shown at (b), with an increase in explosion pressure to 195 pounds per square inch. At K the curve (a) shows proper timing of the spark, with a compression of 52 pounds per square inch, but the result was very poor, indeed, owing to the use of a lean mixture. During the taking of the card (b) the compression was maintained as before, but the area traced by the manograph was materially reduced owing to the lateness of the spark and the slow burning character of the lean mixture. The card L shows about 55 pounds per square inch compression, and the superimposed lines as traced by the manograph indicate a wide variation in the results.

Some Commercial Forms of Magnetos

Splitdorf—This is a high-tension magneto with separate transformer of the type as shown in the section in Fig. 3 and is the product of C. F. Splitdorf, Walton avenue, New York.

Referring to the illustration, the system used is that having an armature with but one winding and giving a current of comparatively low tension. The current is discharged through a transformer having a low and high tension winding somewhat similar to a regular spark coil. The shuttle armature is mounted on two ball-bearings; one end of the armature shaft is equipped with a breaker cam and the insulating plug which delivers the current in the armature to the collector brushes, from which it goes to the transformer and thence back to the contact breaker, and so to the plugs. With the transformer coil a battery can be used and the contact-breaker of the magnet serving as distributor, thus giving two ignitions.

Bosch—This is a high-tension magneto of the type as shown in Fig. 3 and is the product of the Bosch Magneto Company, of New York City. Referring to the illustration, between the pole shoes of two steel horseshoe magnets a shuttle armature rotates; this is wound in two parts, one of which is the primary, consisting of a few turns of heavy wire, and the other the secondary, consisting of many turns of fine wire. The armature is driven at the same speed as the engine. The primary current is transmitted through the armature core to a screw and thence to the platinum screw block of the commutator, in which the platinum screw is fixed. Pressed against the platinum screw by means of a spring is a bell crank-lever with another platinum screw connected to the armature core, and the primary crosses the gap when the lever is rocked. The end of the secondary winding leads to the slip-ring, on which slides a carbon brush insulated from the magneto frame. From the brush the current is conducted to the distributor center contact and from there to the metal segments being rotated by a gear off the armature shaft. The contact distributor shaft runs at the same speed as the cam shaft.

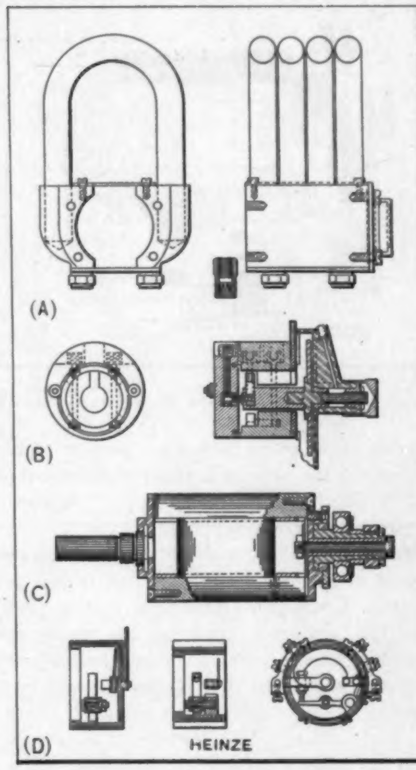


Fig. 5—Heinze magneto, showing the parts and how they relate to each other

U & H—This is a high-tension magneto of the type as shown in section in Fig. 3 and is marketed by J. S. Bretz Company, New York City. Referring to the illustration, there are three pairs of permanent horseshoe magnets that the makers claim never require remagnetizing. Attached to the magnets are two pole pieces of soft core iron which are bored out to receive the armature, which is of the shuttle type or H section, mounted on ball bearings. The windings of the armature are placed one over the other, the inner layer the primary and the outer the secondary winding. One of the main features of this magneto lays in the interrupter. There is no adjustment for the platinum points; a condenser is placed in parallel with the interrupter points and rotates with the armature. The distributor is driven by a steel pinion on the armature shaft and the distributor brush always turns in the opposite direction from that of the armature. A safety gap is also fitted.

Mea—This is a high-tension magneto of the type as shown in section in Fig. 2 and is the product of Marburg Bros., 1777 Broadway, New York. Referring to the illustration, it will be seen that the magnet is of the bell type and is placed so that its own axis coincides with that of the armature, which is of the shuttle type. The bell-shaped magnet is arranged on a special constructed base in two bearings, which permits of the timing of the ignition being effected simply by turning the magneto in the bearings, which permits the intensity of the arc to remain constant at all engine speeds. The contact breaker is placed parallel to the primary winding, and the breaking of the primary

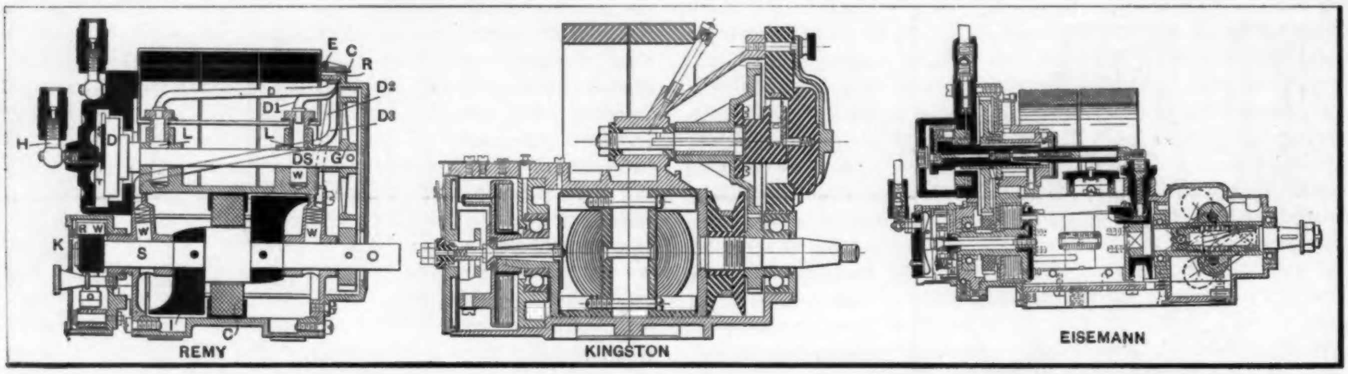


Fig. 6—Sections of Remy, Kingston and Eisemann magnetos, showing the relations of the parts and methods of assembling

current takes place between a pair of platinum screws. In order to control the setting a small transparent window in the driving end is fitted, behind which appear figures indicating the number of the cylinder about to fire.

Volta—This is a high-tension magneto of the type as shown in section in Fig. 7 and is the product of the Buffalo Ignition Company. Referring to the illustration, it can be seen that the armature contains the usual primary and secondary windings and is carried on two ball bearings. A feature of the contact breaker is that it can be adjusted whilst the engine is running. The condenser is situated above the armature instead of on the shaft. The distributor is carried on two ball bearings, with an oiler conveniently situated. The hard rubber housing of the distributor has no high-tension contact segments, but instead the rotating disc has a single T-shaped inlaid brass segment which receives the current from the carbon brush. It is claimed that this prevents arcing from one segment to the other.

K-W—This is a high-tension magneto of the type as shown in section in Fig. 2 and is the product of the K-W Ignition Company, Cleveland, Ohio. Referring to the illustration, it will be seen that the primary and secondary windings are circular in form and stand still, so that the current is taken from the windings and carried to the distributor without the intervention of a commutator and brush. On the type illustrated are five magnets; both secondary and primary windings are stationed in the center of the magnetic field and all shafts run on ball bearings. A safety gap is provided, situated on the condenser housing. The rotor in this magneto is the only part that rotates, and is made from fine laminae of sheet iron and mounted at right angles to each other.

Nil Melior—This is a high-tension magneto of the type as shown in section in Fig. 2 and is the product of the Nil Melior Electric Company, New York City. Referring to the illustration, the magneto consists of a brass base supporting two bronze ends. Connecting the ends are two polar pieces, to which the three double magnets are attached. Between the polar pieces is laminated armature in the form of a double T, on which there are two windings, one heavy and the other of fine wire. One end of the heavy wire is grounded and the other attached to the platinum pointed screw. One end of the fine wire is also grounded and the other attached to the collector C, which by means of the carbon D sends the high-tension current to the distributor D through the intermediary piece P. The rupture is caused by the action of the contact breaker revolving against the fibre cam.

Eisemann—This is a high-tension magneto of the type as shown in section in Fig. 6 and is the product of the Eisemann Magnet Company, West Fifty-seventh street, New York. Referring to the illustration, it will be seen that the latest introduction in the advance mechanism is incorporated, viz., automatic advance. This gives a mechanical timing that can be adjusted to synchronise with the range of speed in revolutions by the engine. This is effected by adding a centrifugal governor, which is in a case at the driven end. The governor acts on a spiral key, which has been the practice on Eisemann magnetos for several years; previously it had to be carried out by a hand-controlled lever. The magnets are of the ordinary horseshoe type and the armature is of the spindle type. A feature of this magneto is the simple method of setting, which is effected by lifting a dust cap and inserting a key supplied with each machine. This key holds the armature in a fixed position and the contacts in the right position when the piston is on the dead center.

Herz—This is a high-tension magneto of the type as shown in section in Fig. 7 and is the product of Herz & Co., Houston street, New York. Referring to the illustration, it will be seen that the magnets are cylindrical in form and consist of several flat steel rings clamped together, with the polar surface or armature tunnel cut in them. The usual pole pieces are entirely dispensed with. The armature is of the shuttle type and mounted

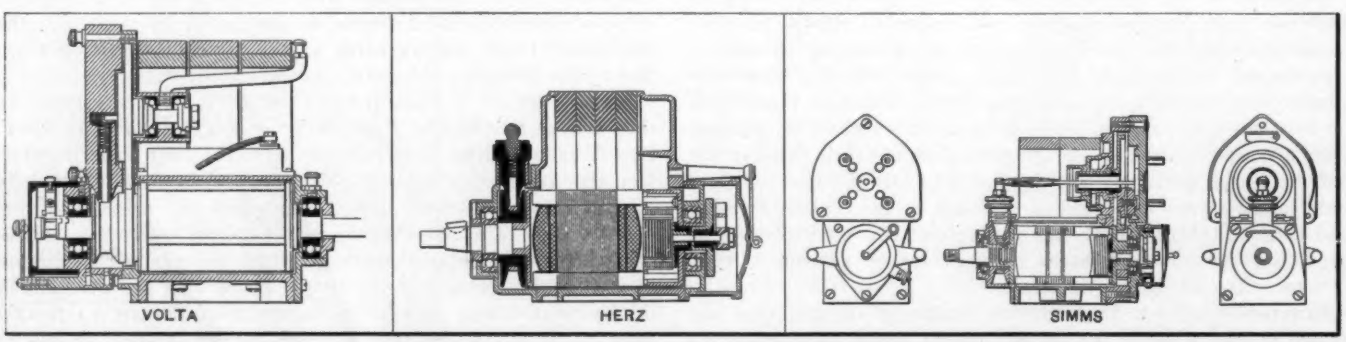


Fig. 7—Sections of Volta, Herz and Simms magnetos, depicting the relations of parts and the methods of assembling

on ball bearings, with cages which hold vaseline for lubricating purposes. The condenser is arranged neatly in a circular recess at one end of the armature. The contact breaker is arranged as a complete detachable unit fitted to the armature shaft by a small keyway and feather. The casing of the machine is aluminum and the only tool required to dismantle it is a screwdriver. A four-cylinder model weighs 8 pounds.

Remy—This is a high-tension magneto of the type as shown in section in Fig. 6 and is the product of the Remy Electric Company, Anderson, Ind. Referring to the illustration, the magnets are of the horseshoe type; it has a stationary winding C which does away with moving contacts in the primary circuit. This winding is embedded in the pole piece. The rotative part is a simple forging mounted upon a solid steel shaft S. At each half turn or revolution the direction of flow of the lines of magnetic force through the coil C is alternately reversed. The magneto winding is directly connected through the magneto current breaker with the primary winding of the induction coil which is used with the magneto. The circuit is mechanically broken during the current wave, which endures throughout over 45 degrees of the inductor's revolution.

The timing of the spark is accomplished by shifting the circuit breaker around the armature shaft, to which is attached the circuit breaker cam. The distributor of the magneto and its 2 to 1 driving gear at the opposite end of the apparatus is for the purpose of distributing the current after it has been sent to the coil and transformed to the high voltage which is required at the sparking plug.

The special spark coil furnished with the magneto is fitted with a two-point switch used to change from battery to the magneto or vice versa, or disconnect from either to stop the motor.

Kingston—This is a high-tension magneto of the type as shown in section in Fig. 6 and is the product of the Kokomo Electric Company, Kokomo, Ind. Referring to the illustration, the field magnets are made of German magnet steel imported for this purpose. The armature is of the usual H section, with laminated core, and the shaft runs in two ball bearings of large size. One end of the primary winding is grounded on the armature core, and the other delivers current to the insulated contact screw of the interrupter by way of the central insulated screw by which the interrupter plate and condenser are held to the armature shaft.

The distributor is at the driving end of the magneto and is driven by gears. The upper gear has a long hub which turns on a fixed stud, and oil introduced through the oiler at the top of the magneto finds its way to the gears and their bearings by holes drilled through this stud, as indicated by the dotted lines in the sectional drawing.

Heinze—This is a high-tension magneto of the type as illustrated in Fig. 5 and is the product of the Heinze Electrical Company, Lowell, Mass. Referring to the illustration A shows two views of the magnets and magnetic field. The magnets are circular in form but of the horseshoe type and these fit into carefully reamed holes in the pole pieces. The current generated by the magneto is low tension and is stepped up by the use of a separate transformer. The distributor is part of the magneto and the transformed current is distributed therefrom to the plugs.

Connecticut—This is a magneto of the low-tension type with separate transformer which forms part of the magneto proper as shown in Fig. 8 and is the product of the Connecticut Tel. & Electrical Company, Inc., Meriden, Conn. The magneto has a single winding running to the switch as secondary wires connect from the magneto direct. There is a slot in the side of the interrupter provided as a guide for a small file provided for the purpose of cleaning and squaring up the contact points. The interrupter housing is reversible which allows the advance lever to be placed on either side. The condenser and primary and secondary windings are housed in the transformer, which is screwed into the magneto.

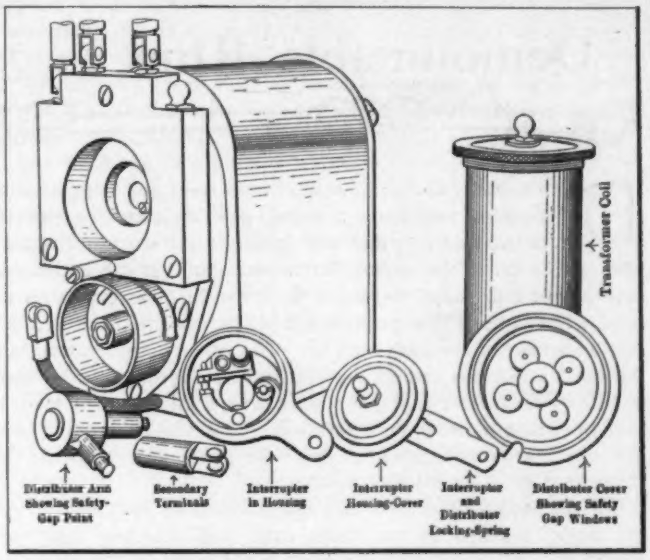


Fig. 8—Connecticut magneto partly assembled showing the relations of the parts.

Simms—This is a magneto of the high-tension type as shown in section in Fig. 7 and is the product of the Simms Magneto Company, 1780 Broadway, New York. Referring to the illustration will be seen one of the types manufactured by this concern. The size is small and compact and notwithstanding this the armature has a very large winding which has been made possible by placing the condenser between the armature cheeks. Another feature of this type is the rotating safety spark gap. The magnets are of the conventional horseshoe type and the armature of the spindle type.

Vesta—This is a magneto of the low-tension alternating type as shown in diagram in Fig. 7 and is the product of the Vesta Accumulator Company, Chicago, Ill. Referring to the illustration, the wiring diagram will be seen. The current from the armature is stepped up through a transformer or non-vibrator coil having a primary and secondary winding. A feature of the magneto is the moveable pole pieces. These the makers claim permit the retarding and advancing of the time of firing without decreasing the efficiency to the engine and also permitting the slow running of the engine on a retarded spark. Ball bearings are used on the armature shaft. The transformer coil is pancake wound, so arranged that a six-volt storage battery can be operated on one side.

Wico—This is an igniter of the type as shown in section in Fig. 4 and is the product of the Witherbee Igniter Company, Springfield, Mass. Referring to the illustration it will be seen that the igniter is a generator of current producing a high-tension spark and unlike some high-tension magnetos the strength of the spark is independent of the speed at which it is driven. In addition to this it is capable of producing a spark by the simple movement of the ignition lever before the engine has begun to rotate.

Briggs—This is a magneto of the type as shown in Fig. 4 and is the product of the Briggs Manufacturing Company, Elkhart, Ind. Referring to the illustration the magneto is of the low-tension type having but one winding on the revolving armature. In order to secure high voltage a step coil is used with which is incorporated a condenser. There are six horseshoe magnets made from tungsten steel and the armature of the spindle type is carried on ball bearings. The circuit-breaker is shown separate and when the cover is removed it is possible to get at any part for adjustment with great ease.

Demountable Rims

PRESENTING A SELECTION OF THE VARIOUS SCHEMES USED TO FACILITATE THE REMOVAL AND DISPLACEMENT OF TIRES ON WHEELS

DEMOUNTING is necessary whenever the tires become disabled and there are two good reasons for desiring to use methods that will facilitate the work. The main idea is to remove the damaged tire in order that the automobile may be put into shape to render it fit for further service on the same efficient basis that presented itself before the puncture, rim-cut, or bruise as the case may be. The other consideration, and the most important one in a sense, lies in affording to the automobilist a means for doing the work with a minimum of labor so that he will not delay the operation. If a task is fraught with difficulty it is human nature to delay the proceeding, and it is this delay that is so destructive to tires.

But the automobilist who may have driven all day and far into the night, perhaps in the dark, cold, and drizzling rain, will scarcely be likely to feel like getting down in the mud of the road and tugging on a rusted "clincher"; this will surely be true if the trouble comes on just when home looms up ahead and yet it is just this short distance that will cost more than the run of a month on an average basis of perhaps 25 miles per day. There is no use in saying that the automobilist who will run on flat tires for even a short distance should stew in his own juice. The right method to use is the one which will invite repairs under the most unfavorable conditions, and demountable rims with detachable features are intended to answer all of the requirements in this regard.

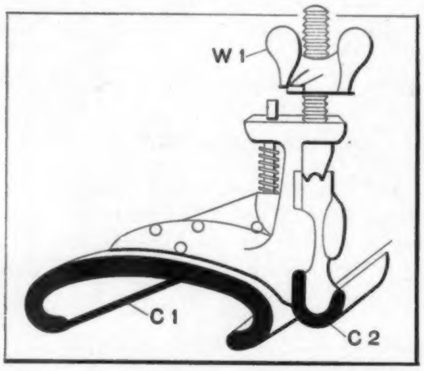


Fig. 1—Sketch of the fastening of the Stepney spare wheel

In discussing this problem it is the intention to include all the forms of detachable and demountable rims, remembering that there are various trade names for them, but the fundamental idea underlying all of them is in common, that is to say, all are made for the purpose of facilitating the quick and easy change of tires, substituting a good tire for a damaged one, quickly, and without that distressing form of labor which is disagreeable to all automobilists and beyond the man of no great strength.

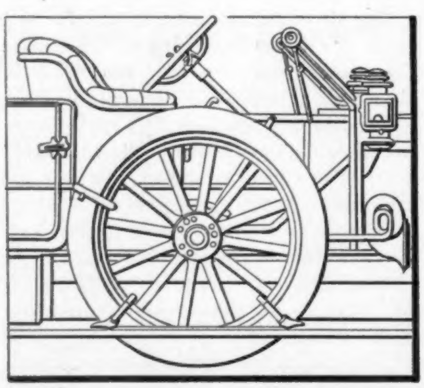


Fig. 2—Spare wheel as carried on the running-board of Rambler cars

There are several plans in vogue; making a temporary repair is the point in mind when a spare wheel is used as in the Stepney supplementary wheel as presented in Fig. 1, in which C1 is the clincher rim, C2 is the clamping rim by means of which the Stepney wheel is held to the rim of the regular equipment, and W1 is the wing-nut, which, when screwed down, holds the clamp C2 tightly in place. In this supplementary wheel it is but the work of a moment to fasten it alongside of the regular wheel, even without removing the damaged tire, and go on for a considerable time without having to give the tire question a moment's extra thought.

Still another idea is represented in the spare wheel used on Rambler automobiles. The Rambler plan is to carry a spare wheel strapped in the sling on the running board of the automobile, as shown in Fig. 2. In this plan it is the aim to take off the damaged tire with its wheel, and the mechanism of the car is so contrived that it takes but a moment to undo the fastenings at the hub of the wheel, slip the old wheel off and substitute the supplementary one, employing the same mechanism for fastening the same into place. At a convenient time in the garage the damaged tire may then be removed from the spare wheel and when a new tire is put on the wheel is then strapped back in the sling on the running board ready for another experience of the same kind. This idea is gaining a strong footing.

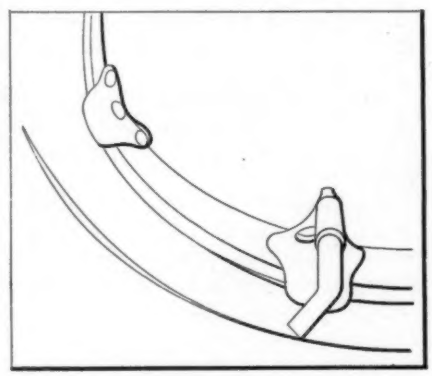


Fig. 3—Sketch of the Jenkins spare wheel fastening

The Jenkins emergency wheel as shown in Fig. 3 represents another variation of the spare wheel plan. In this wheel a clincher rim is used and it is held in place by means of six steel plates which are riveted to the inside of the rim at an equal distance apart. Every alternate set of plates is provided with a journal with a hook equipped with a round shank standing at right angles to the plane of the wheel. The bent ends of the hook are so shaped as to engage the clincher of the regular rim, holding the emergency wheel securely in place.

Perhaps the next logical plan in the order of rims is represented in split forms one of which is shown in Fig. 4, of the Goodyear-Doo-

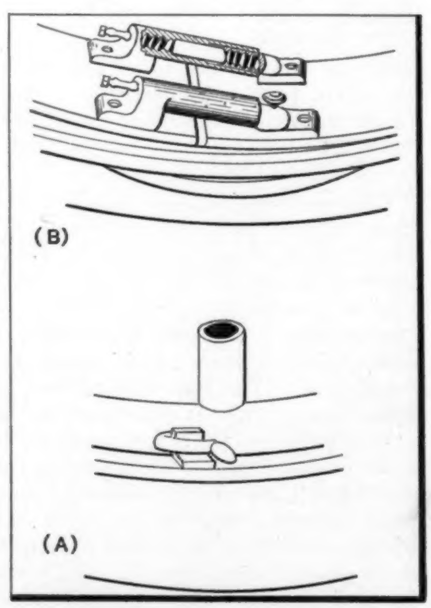


Fig. 4—Two views of the Goodyear-Doolittle double turnbuckle method of holding a split rim.

little mechanism, and another is represented in the Universal rim as shown in Fig. 5. The Goodyear-Doolittle rim is presented in two views. (A) shows a pair of turnbuckles secured to the inner surface of the split rim, they being housed in on a telescoping basis and by means of right- and left-hand threads the two parts of the rim are drawn toward each other when the rim is being secured into place. After the shoe, with the tube in place, is mounted on the rim and fully inflated, the rim is then put on the wheel with the vent stem in the valve hole. The felloe band supports a pair of angle iron stops that are riveted to the split-clincher rim.

In the Universal rim as shown, a regular stock clincher rim is first sawed through at one point of its periphery, and a roller-cam is fitted to it so that when the tire is put on and the rim is set upon the felloe band, by means of a socket wrench the roller-cam is turned around until it drops into a recess provided for it. The rim is constricted in this way and the tire is then inflated.

Forms of Rims That Are Not Separated

In this class there are a considerable number of rims; novelty as between them lies in the forms of the mechanisms and a considerable display of ingenuity has been displayed.

The Midgley demountable rim is illustrated in Fig. 6. This rim comprises a wide felloe band to which is fitted a supplemental band outside of the clincher. The special rim is split at one point and at equidistant points around the periphery it is sawn into for a distance reaching more than half way across, the idea being to induce suppleness, so that the rim will nest closely and mind the further manipulation. The rim must be given a twist when it is being fitted or removed, and the sawn places add to the facility with which this operation may be performed. A means is afforded for meeting the ends of the split portion after the tire has been mounted on the rim and it may then be inflated. When the rim is mounted on the wheel it remains to apply the locking rings, which are also split, and so shaped as to fit over the supplemental bands. The ends of the rings are drawn together by means of bolts. From what has been said, it is evident the Midgley rim is of the semi-split genera.

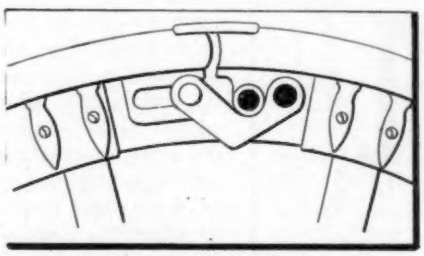


Fig. 5—Method of holding the Universal split rim

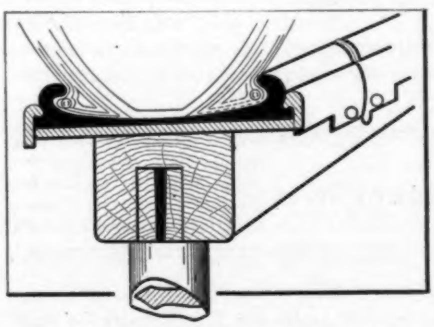


Fig. 6—Midgley rim shown in section

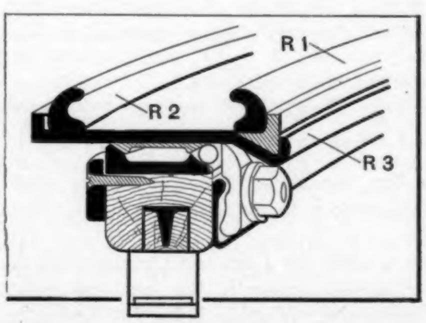


Fig. 7—Section of the United rim at point of clamping

Another form of rim that is near-related to split forms is the United. This rim is illustrated in Fig. 7. Provision is made to accommodate either clincher or straight-edge tires. The construction includes an endless and a split portion of the clincher member. The endless ring R1 seats against the angle formed by the rim proper supported by an upturning part R3. The ring R2 is split and drops into place readily.

Referring to Fig. 8 of the Standard quick detachable rim it is comprised of reversible side rings for use with either clincher or Dunlop tires. The side ring seats over the formed locking ring. The wheel felloe band is of rolled stock. A series of clamp wedges are used, and they are fanned out where they engage the felloe and tire rims, thus increasing the bearing surface.

A very simple form of demountable rim of the split clincher type is shown in Fig. 9, as brought out by Byam, comprising a felloe, F1, and a felloe rim R1, with a supplementary rim R2, and a split clincher comprising two members M1 and M2. The supplementary rim R1 is held in place by six radially disposed bolts B1, screwing into bronze bushings which in turn fit into the fellow rim.

The Fisk rim as shown in Fig. 11 comprises a felloe rim with an angular portion, a supplementary rim, with off-set faces, and a thin outer rim which takes the flat clincher of the shoe. Endless rings pass around over the beads of the tire base, and are held laterally by cross bolts. In demountable work the base of the rim is made with a hollow drop center with a view to increasing the inside locking contact. The shape of the felloe band with its wide bevel face on one side assures easy release in demounting, even after several months of service with its accumulation of rust and compacted foreign matter.

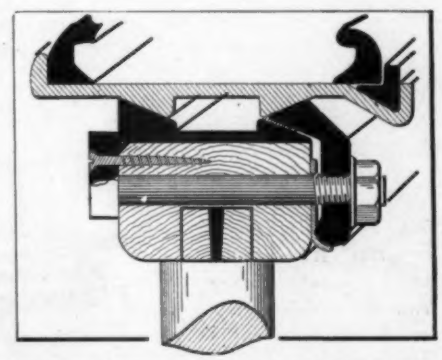


Fig. 8—Section of the Standard rim, showing how it is held in place

Referring to Fig. 12, of a Michelin demountable rim, the felloe band F1 is flanged down over the face of the felloe on one side and takes an angle in the upward direction on the opposite side. The clincher rim R1 slides over into place, and wedges R2 are fetched up against the free side. These wedge-like lugs are held in place by a special form of bolts around the periphery, and the heads of these bolts are shaped to serve as limit stops, thus keeping the tire central on the felloe.

In the Continental demountable rim as shown in Fig. 13 a supplementary felloe rim R1 is flanged in the outward direction at one side, and is

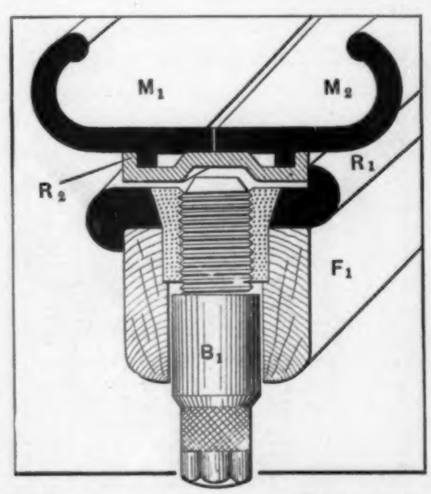


Fig. 9—Byam rim, showing how it is held in place using two clincher members

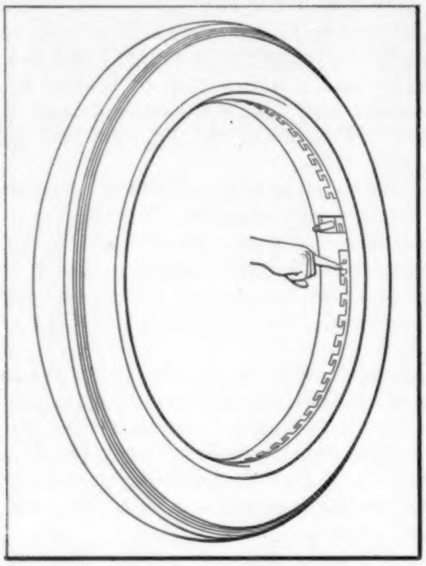


Fig. 10—New Continental demountable rim, with bayonet joint locking device

turned down over the felloe on the opposite side. The clincher rim R2 is slipped over and into place, and is wedged out by the lugs L1 held by special bolts B1.

Another form of demountable clincher rim is shown in Fig. 14 and known as the Empire. In this example the supplementary rim is in two parts R1 and R2, overlapping and riveted in the manner as presented; the clincher rim R3 is held in place by resting upon the upward turning flange of the felloe rim R1 on one side, and by lugs L1 at the other side. The lugs are shaped to the curvature of the clincher at their outward extremity, and with toes fashioned upon the other end they rest upon a ledge R2 holding bolts B1.

The Dorian rim is shown in section in Fig. 15 with a clincher rim R1 resting upon a supplementary rim R2 which is upward flanged for the necessary support on one side, and a series of wedges W1 give support on the opposite side. Each two wedges around the periphery are tied together, and are held by bolts B1, and by means of a washer W1 in conjunction with a nut N1.

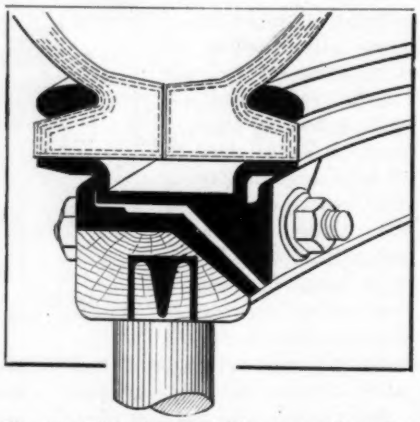


Fig. 11—Fisk demountable rim with a flat rest of the tire and method of clamping

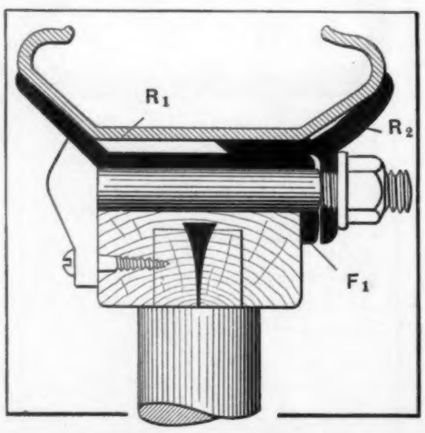


Fig. 12—Michelin rim using a clincher, showing how the same is retained

The Dow rim is shown in Fig. 16 utilizing the principle of the wedge in conjunction with a rack and pinion take-up. There are eight sets of these wedges spaced around the felloe over the felloe band engaging with the inner face of the clincher rim. The hole in the felloe for the tire valve is enlarged for convenience, and a steel socket is fitted in for the accommodation of a special tool, by means of which the rack pinion is rotated and the rack is set in motion. The rack segment is fastened on the side of the clincher. By revolving the pinion the rim is revolved in the opposite direction on the felloe band, and the wedges are drawn toward each other, binding the clincher rim.

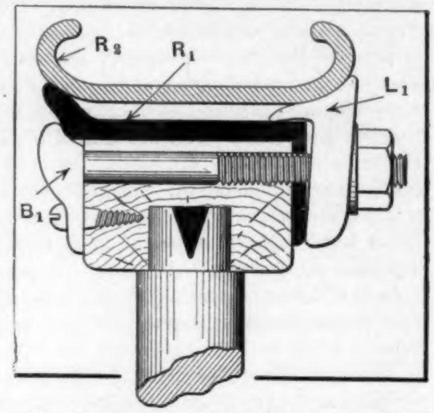


Fig. 13—Continental clincher rim arranged for quick work

Fig. 18 shows the Denegre type of rim. In this example the clincher rim is of considerably greater diameter than that of the wheel as measured over the felloe band. To the clincher rim R1 wedge-shaped members W1 are riveted, and they in turn engage with relating members W2 on the felloe band. The felloe band is flat, and its wedges are cold-riveted to its periphery. A longitudinal groove is cut in each of the wedges correspending to tongues which are fashioned on the mating wedges. The tongued wedges on the inner periphery of the clincher rim taper off in both directions to facilitate mounting. In mounting the rim it is placed over the wheel, the valve is then inserted

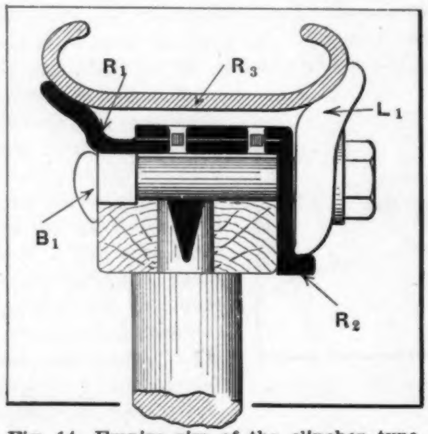


Fig. 14—Empire rim of the clincher type and method of retaining the same

Properties of Magnet Steel

Comparing Tungsten Steel of a Given Carbon Content With Carbon Steel of the Same Content

UTILITY, as it is measured in steel used for permanent magnets in magnetos, depends upon the flux density in lines per square centimeter, and it has been found in practice that the presence of tungsten increases this flux density from 15 to 20 per cent., offering the further advantage of a high retentivity.

One well-known brand of tungsten magnet steel has a composition as follows:

CHEMICAL COMPOSITION

Tungsten	Carbon	Silicon	Sulphur	Phosphorus	Manganese
5.5-6	.80-.90	.15-.25	.03	.015	.30-.35

Note.—The sulphur and phosphorus contents as given are for maximum values.

A good value of the flux density in lines per square centimeter, for the above steel after it is properly heat-treated is in the region of 40,000.

An equally good grade of steel of a chemical composition as above fixed, excepting tungsten, which is left out, delivers a lower magnetic flux density, the reduction being in the region of 20 per cent., making the normal expectation approximately 32,000 lines per square centimeter.

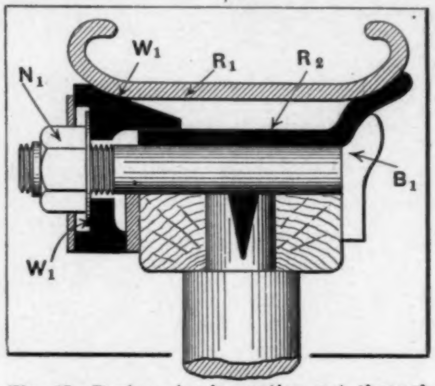


Fig. 15—Dorian rim in section cut through the point of wedging

in the opening, the latter being slightly elongated, in which position the relating wedges are in juxtaposition, and the rim is then rotated with the wheel standing still, bringing the wedge-tongues into engagement with their corresponding grooves up to the limit of hand pressure. Final locking is done by a system of flat wedges actuated by a toggle key, and this process is consummated at five positions around the periphery of the wheel. In locking, the nut on the cross-bolt of the key is tightened, and the wedges are drawn together transversely, moving the clincher rim relative to the wheel to the limit of desired tightness. To remove the clincher rim, the same operations are performed, excepting that the key is inserted in the wedges to impart a reverse rotation.

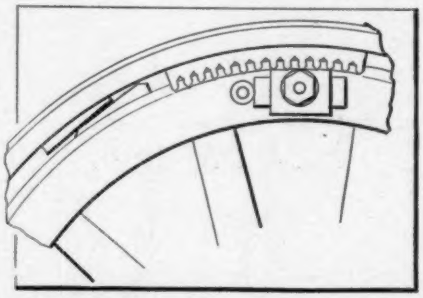
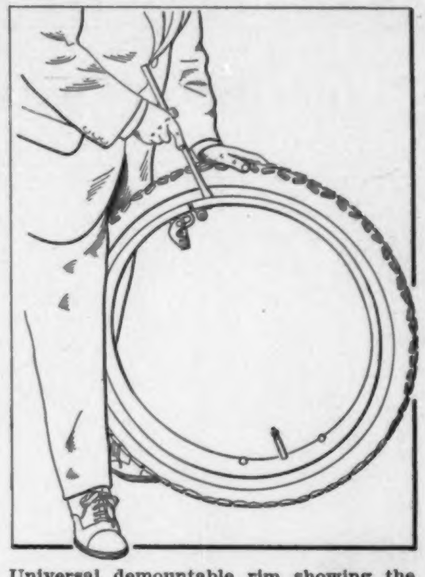


Fig. 16—Dow rim using a rack and pinion method of pulling up against a system of wedges

The Firestone demountable rim is shown in Fig. 19. The locking device consists of a wedge-shaped ring held in place between the bevel of the felloe band and a similar face of the tire rim. This construction holds the quick detachable as well as the demountable feature. The lock ring is split.

In addition to the rims as here illustrated there are some new features to be seen at the Garden, among which will be mentioned the methods in vogue in the taking off and putting on of the Dorian rim, remembering that there are no separate parts to get lost, moreover, it is the ease with which the work may be done that is attracting much notice.



Universal demountable rim showing the use of the tool used for indoing it

The quick detachable, demountable rim as made by the United Rim Company, is shown in four styles. No. 1 is used with all makes of straight side and clincher tires. No. 2 is used with all straight side and clincher tires. No. 3 is for clincher tires and the remaining style is for straight tires. The exhibition is complete and the interested spectator is enabled to examine the rims with minute care.

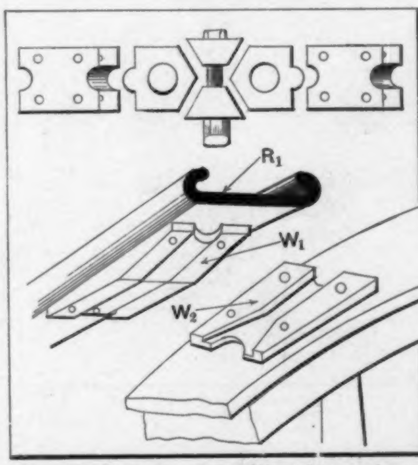


Fig. 18—Denegre rim with a large clearance between the rim and the felloe band and method of fastening

The Fisk removable rim is shown at the Garden, and it may be found at space No. 178, balcony. This rim indicates that it is designed for light weight, ease of adjusting and removing, and it is claimed that it will not stick.

The Standard Welding Company at its exhibit at the Garden is showing its latest effort in rim work, and is emphasizing the main advantages that are to be found in its construction. The Standard universal quick detachable rim fits straight side or Dunlap tires.

The Booth Demountable Rim Company, of Cleveland, Ohio, is at the Garden with a rim that is being demonstrated to the interest of the spectators. Those who go to space 259 come away well pleased.

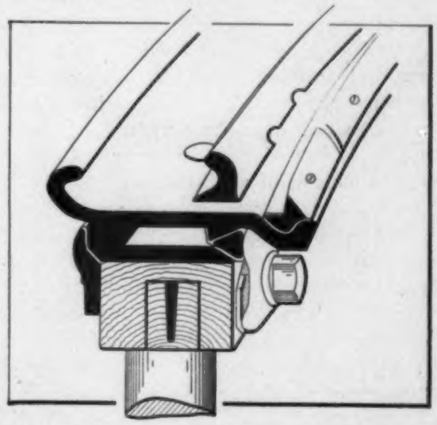


Fig. 19—Firestone rim in section, presenting the method of fastening

Safe Racing? A Delusion! But Racers Might Practice On Accidents and Gain Skill to Avoid Injury

COMPLAINT has been rife among manufacturers as well as in the press, that race managers after these many years of trying are still unable to provide a safe race. Of course, there are finances involved. The contracted course, with cars passing the grand stand every minute, has charms to the manager whose sporting enthusiasm is identified with the box receipts, and the road which produces drastic episodes by means of inexpensive road improvements is dear to his heart wherever the latter may be located. Undeniably a few road difficulties test out the racer's mettle and judgment. Whether Nazarro's 74 miles per hour on roads beyond reproach hold more of the true juice of sport than a held-back, 62-mile clip on roads of average American excellence, is a question whose answer in the absence of convincing data may well be answered by the pocketbook, unless one stops to bother with humanitarian aspects, which the racing drivers themselves are slow to appreciate, since they interfere with their pocketbooks, too. The risk is paid. The crash is actuarian. But both are paid by the manufacturer. With a view to reducing the risk without diminishing the popular interest, has everything possible been done?

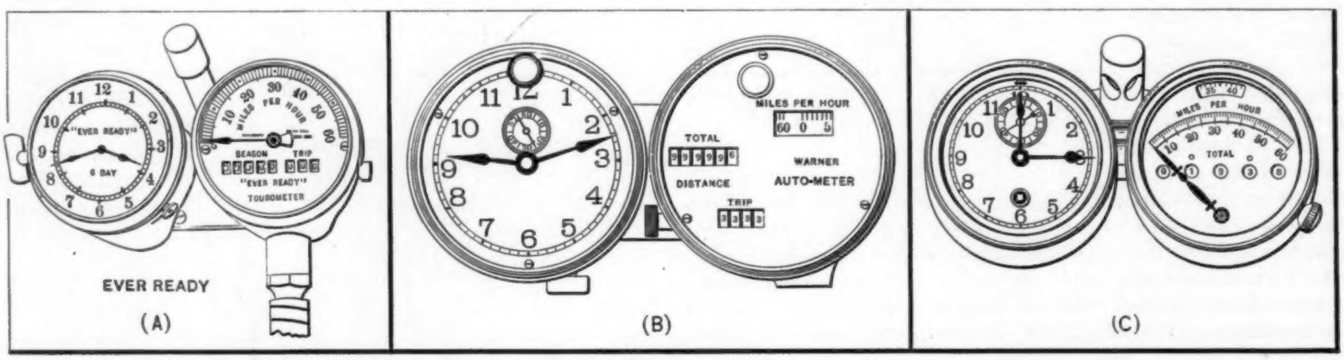
Speed and Distance Recorders

DISCUSSING THE MEASUREMENT OF SPEED AND DISTANCE AS RELATED TO AUTOMOBILES, ILLUSTRATING THE SEVERAL MAKES OF INSTRUMENTS THAT MAY BE UTILIZED

WHAT a strange thing it would be were it true that speed measuring instruments were purchased for the sole purpose of trying to prove to the guardians of the law that the automobile is not traveling at a law-fracturing speed—the instruments would all have to read slow. No less curious would be the idea of equipping an automibile with an instrument that would read fast just to facilitate the plan of making casual acquaintances believe that a little runabout is a racing automobile. It would be like having a watch in one's vest pocket for no better purpose than to tell him that he was in ample time for a train that he just missed. Perhaps, under certain conditions, instruments that do not tell the truth are good to have. Take the clock of time; could it be induced to slow down so that the date of departure of mortals from earth's ramble would be prolonged, what a joy it would be for the more wicked of them; the reverse might hold for the good and pure, the idea being that if Heaven is such a good place the sooner one gets there the better it is for him.

it equipped with a reliable speed and mileage indicator; will he spend a fleeting moment in inquiring as to the make and character of the timepiece that is placed in an ornamental case on the dash? If a timepiece is of such great importance to a man, how is it that the mileage recording instrument is of such little value as to be disregarded.

Let us take a case; assume that an automobilist is the possessor of a thoroughly good automobile and a $400 watch; let us assume also that his automobile is fitted with a road map, or some other device, let us say that is far from accurate, and that the unhappy automobilist decides to go for a ride of a few hours pending the keeping of an important engagement. The watch in his pocket will do its duty; true, but what good will the watch do if the road map lies, if the speed and mileage equipment puts the poor automobilist many miles out of his reckoning; he may risk his neck, drop into a police drag net, do hundreds of dollars' worth of damage to his good automobile, but he will have to apologize for breaking an important



(A) Ever Ready Speedometer. (B) Warner Auto-Meter. (C) Standard Speedometer.

At all events, since it is desirable to keep track of time and of distance, it devolves upon the builder of accessories to specialize on good precision measuring devices; and makers of automobiles, recognizing the hold that this form of equipment already has on automobile users, can do no less than supply the demand. In view of the necessities, and the thoroughness of the service, the ordinary clock, like the poorly built speed recorder, is of little or no value. When account is taken of the fact that a watch, and, for that matter, a fine chronometer, is influenced by heat, cold and position, and that a watch will go fast or slow, depending upon the physical movements of the carrier, it is easier to understand why there should be quite a little trouble with an instrument, as a clock, if it is fastened to the "dash" of a swift moving automobile, particularly when the roadbed is like the ice that "Eliza" crossed in her mad desire to acquire a measure of solitude, at least as much of it as would keep Simon Legree speculating.

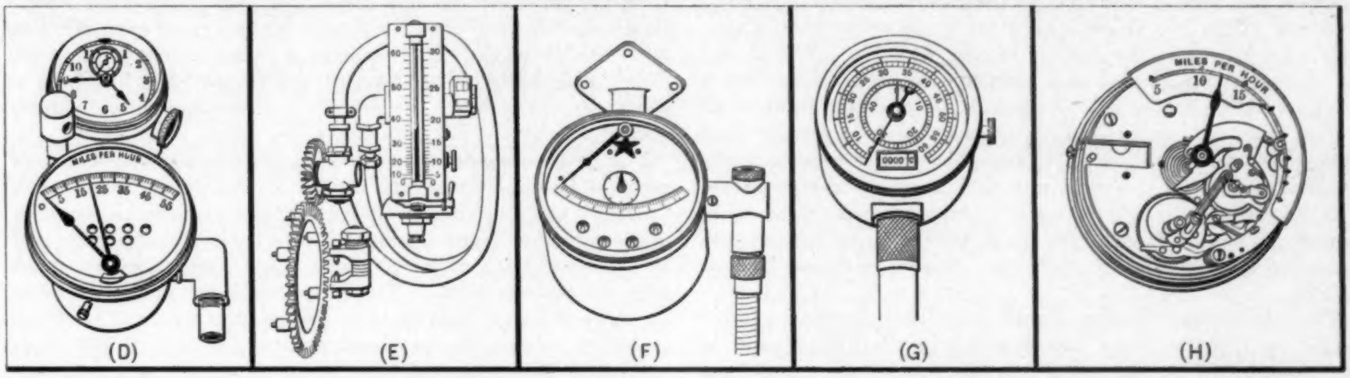
Is it not strange that thinking people dispose of some matters with a rush and putter over less important details to an extent that becomes tiresome betimes? Take the man who is dissatisfied with even the best timepiece that money can buy, who frets and fumes about a loss of a fraction of a second in a month of running; let him go in quest of an automobile and it is more than likely that he will buy a good car, but will he have

engagement, which, if it happens to be his own wedding, the charming, but disenchanted, Juno, like gold racing away from a poor man with a large family, will be off.

Of course, there are compensations; Juno's sister may be more patient; the same mother-in-law will then reign over the knight who places reliance upon a "turnip," but, as a rule, it is foolish to pay good money for poor instruments; and, when it is considered that even an automobile, if it is poorly made, will cost more in the long run than a well-contrived mechanism, there seems to be little ground for the existence of an inferior device, nor is it possible to reason for the type of automobilist who will invest in a brass-bound uncertainty.

Judgment, Betimes, Exhibits Queer Freaks

It is not uncommon to observe the type of man who, having a relatively slow-going automobile, refrains from equipping it with good, reliable mileage recording instruments, and, in lieu of a timepiece, it is a magpie trait of character that goes in for a shining case guarding in its maw a seven-jeweled freak. What is the result? The watch, or clock, whatever it may be, will not keep time. Then, the mileage recording instrument, like Pandora's box, has every variety of mystery within it's confines, but when it comes to distance recording, all the miles it tells about are marked different from each other in point of length;



(D) Jones Speedometer. (E) The Veeder. (F) Star Speedometer. (G) Hoffecker "Steady Hand." (H) Cleveland Indicator

some are long and some are short, but the automobilist, not being a fortune-teller, fails to average them up correctly, and, with his relatively slow automobile, he is reduced to the infernal expedient of trudging along, blindly groping, hoping, perchance, that the lying instrument, through some freak of nature, may have told one in his favor—no such luck.

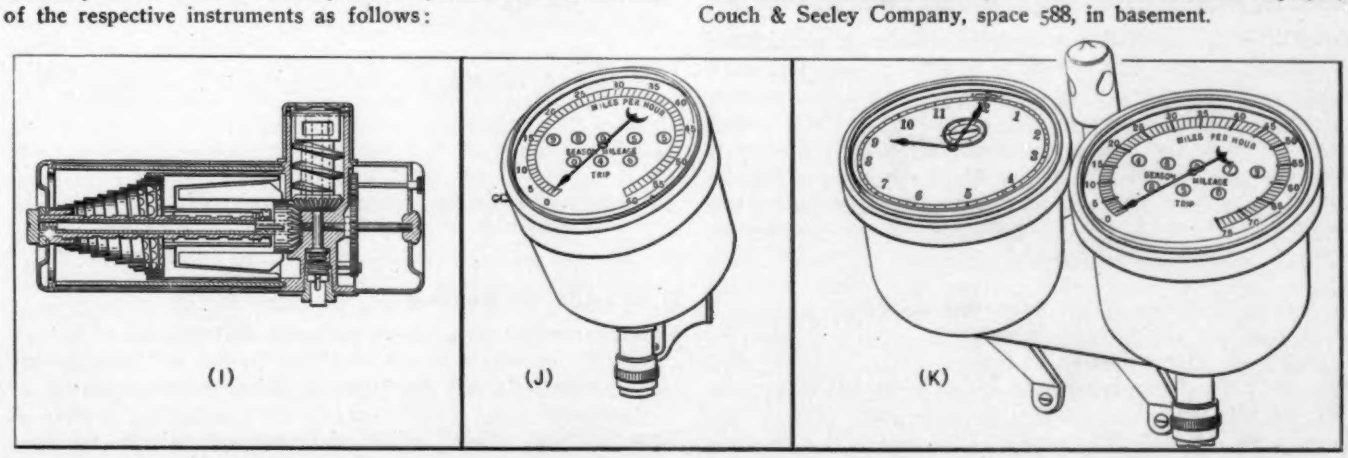
It would seem, from a cursory examination of the relating circumstances, that the slower the automobile the more accurate the mileage recording instrument should be, for, if the car cannot go fast and far, it is all the more reason why it should be guided with certainty, and it remains for the automobilist of acumen and discrimination to add just a little more to the purchase price when he goes to select the automobile, and, by so doing, save himself the bad half-hours that fall to the lot of Ananias' boon companion; the instrument that is only good to look upon, but whose truthfulness cannot be vouched for.

It is fortunate that the market affords a wide selection of good instruments, the kind that may be relied upon to tell the wondering automobilist just how far he may have traveled; and it is also possible to obtain excellent timepieces, either combined in the same case or separate. But it is necessary to pay the price, and it is desirable to keep away from mere innovations. Select the instruments for this important work with good care; make up the mind that the price is a mere matter of knowing how much it is in order to pay it. With a good mileage recording device, a proper speed indicator and a suitable clock, all that remains to frame touring with the gold of pleasure is in the form of a reliable guide book. Of the best that the market affords the exhibitors have them, and the very fact that they may be inspected at leisure will render it unnecessary to proling the descriptions of them here; as a reminder of the makes that may be seen at the Garden, however, brief mention is made of the respective instruments as follows:

Ever Ready Speedometer—Operated by centrifugal force, the Ever Ready Speedometer calls into play a particularly well-known principle. The manufacturers offer for sale seventeen types of speed measuring machines, ranging from bicycle meters to elaborate instruments for recording speeds and distances in various kinds of automobiles and motorboats. In connection with this line the company presents an eight-day clock of substantial design and compact size. A separate maximum speed hand is a feature of the line. Shown in booth of the Auto Improvement Company, space 241, in balcony.

Stewart Multipolar Speedometer—Four permanent magnets, machined from Tungsten steel, form the actuating principle of the Stewart multipolar speedometer. These magnets are embedded in a ring of non-ferrous material. This is inclosed in a casing of metal. The power is applied through a spindle which turns internal bevel gears, running on ball bearings. Thus the shaft which turns the indicating hand is moved and the rate of speed is shown upon the dial. The odometer mechanism is driven from the same spindle by means of a hardened steel gear train. Twenty-one models are included in the current line, ranging from the smallest and simplest styles to those of great elaboration. Shown in space 230 in balcony.

The Casgrain—Liquid confined within a cylinder in such a way as to make its escape impossible, is the active principle of the Casgrain speedometer. Small steel paddles are rotated inside this cylinder by power transmitted from the drive. The connection with the driving shaft is made above the level of the liquid. The current set up in this way causes a drag or friction on a series of blades which are connected with the dial. This is rotated on a spiral spring in proportion to the speed of the paddles. The scale is 28 inches long, passing around a cylinder 2 1-8 inches in diameter 4 1-2 times. Shown in display of Couch & Seeley Company, space 588, in basement.



(I) The Casgrain Speedometer. (J) Stewart Speedometer. (K) Stewart Speedometer, with clock and electric light attachment

Cleveland Speed and Time Indicator—Combining three elements of use in a single instrument is one of the chief claims made for the Cleveland speed and time indicator. This device is arranged to show the total running time, the rate at which each one-thirtieth of a mile is traveled and the total distance, all on one dial. The motive force is applied through a flexible shaft connection to the automobile wheel. The master gear and cam revolves thirty times in each mile and transmits energy to the dial mechanism through the agency of an arm and plate. The motion of the pin is governed by a balance wheel through the escapement device of the indicator. Shown in space 254, in balcony.

The Hoffecker "Steady Hand"—In the operation of the Hoffecker "Steady Hand" speedometer the indicating hand is energized by an expander built on the principle of centrifugal force. This forms a balanced governor, running on ball bearings. The connection between the governor and the indicating hand is through a lever combination, controlled by patents, and is given steadiness by a progressive system of interruptions by the levers. Six types of the Hoffecker are included in the regular line, some of which are twinned with substantial clocks. The power is transmitted to the device from a point in front of the front axle by means of a flexible shaft driven by a small gear meshed with the car wheel. Shown in space 236, in balcony.

Star Speedometer—One of the moderate priced speed-measuring instruments in common use to-day is the Star speedometer, made by the Star Speedometer Company, of Danville, Pa. It includes upon its dial a hand and scale to show the rate of speed being made by the car and an indicator to tell the number of miles traveled. Above the speed scale is a small hand which shows the progress of the car over a single mile. The instrument is driven by the familiar flexible shaft mechanism from the inside flange of the front wheel. Simplicity of mechanical construction is one of the points emphatically made by the company in presenting its line. Shown in basement, space 619.

The Veeder Instruments—Operated by spur gears from the front wheel flange of the car, the Veeder odometer has the benefit of a direct drive. The gear has a tooth of twisted form for cutting the mud and has a considerable range of endwise adjustment. In its simplest form it has only one indicator, but the more elaborate instruments have two to measure trips and total mileage. The tachometer combining the principles of the odometer with a speed indicator. This device is operated by a liquid centrifugal system, run by paddles at a speed corresponding with that of the car. Ball bearings are used at both ends of the shaft. The dial is in the form of graded scale and the speed is shown by the level of the fluid in a thermometer-like column. Shown on elevated platform, space 124.

The Jones Speedometer—Among the well-known types of speed-measuring instruments the line of the Jones Speedometer Company has a prominent station. These instruments are made in two principal divisions, those of the horizontal governor type and those of the vertical governor type. Both styles are made with and without clocks. The horizontal governor speedometers are more elaborate than those of the opposite type and are listed at higher prices. In the simplest form the dial of the Jones instrument shows rate of speed, distance of trip and total distance, just as it does in the highest-priced devices marketed by this company. The distinction between the types lies in the fact that in one the drive is carried to the instrument from the side, while in the other it comes from below. Shown in space 140, on elevated platfrom.

The Standard Speedometer—Attachable to either front wheel of the car, the Standard speedometer, made by the Standard Thermometer Company, is somewhat different in principle from other varieties of speed-measuring instruments used by motordom. In addition to the usual features of a speedometer this one shows the speed and distance while backing. The trip odometer may be set either back or forward. Among the features of this device is its equipment with a universal pivot joint. A number of models are included in the line offered by the company, but the most popular so far with the motoring public is the type shown in the accompanying illustration in combination with a clock. Shown in space 286, in the balcony.

Warner Auto Meter—Driven at a slow rate by means of a shaft device, the Warner auto meter is subjected to less strain than if its motive power was delivered at a higher rate of speed. The simplified drive is one of the basic features of the device. The line comprises many models and styles and has been before the motoring public for many years, being familiar generally. In the standard instruments the case is made of substantial drawn brass. The silvered dial is covered with bevel glass and shows the rate of speed, distance of the trip and total distance of the season or several seasons. Clocks of several kinds are optional with a number of the models. Space 172, on elevated platform.

Delayed Valve Closing

When a Helical Spring Is Used to Close the Poppet Type of Valve

TIMING valve opening in a well-made motor is a relatively simple matter; leastwise it is possible to do the work along positive lines on account of the employment of a positive motion, but when it comes to the consideration of the closing of the valves, in view of the fact that this work is done by a spring, it is not so sure that the effort of the operator will be attended by such a wide degree of success. The influencing conditions, over which the workman has no control, are as follows:

Let,

t = time of closing of the valve in seconds;

w = weight of the valve in pounds;

L = lift of valve measured in feet;

W = work the valve-spring must do as measured in pounds of pressure exerted;

h = lift of the valve in inches;

a = acceleration of the mass in inch-second units;

When,

$$a = \frac{2 \times h}{12 \times t^2}$$

$$W = \frac{w \times h}{32.2 \times 6 \times t^2} = \frac{w \times h}{193.2 \times t^2}$$

= pounds required to close the valve in t seconds;

or,

$$t = 0.072\ h \frac{\sqrt{w}}{W}$$

= time taken in the closing of the valve of a given weight, considering a given lift, friction not included.

It Stands to Reason—

That the merchant who wants the appellation, "captain of industry," but who does not go to the Garden and look at the commercials, will have trouble being mustered out as a corporal.

That the "high private" of all the merchants will be the one who sticks to horses "'til the cows come home."

In the Carbureter Field

ILLUSTRATING THE VARIOUS MAKES OF CARBURETERS, SHOWING HOW THEY ARE INSTALLED AND DISCUSSING THE NATURE OF THE PROBLEM, WITH A FEW REMARKS IN REFERENCE TO THE FUTURE POSSIBILITIES

USERS of automobiles and those who hope soon to join the ranks are wont to delve into the technicalities of automobile making, and that they find it difficult to accomplish some of the tasks is not to be wondered at, since it takes skilled designers a number of years to familiarize themselves with even the most necessary of the details involved. That the carbureter is something of a stumbling blocks seems to be true and, looking the matter over with a keen eye, rather leads to the conclusion that the reason for such confusion as there is may be traced to the apparent simplicity of the device coupled with the fact that it is most complex and unfortunately, for its easy understanding, it is correlated with a series of complex relations, among which may be mentioned the magneto, coil, battery and the hydrocarbon fuel used in this work.

It is a great misfortune that it is not possible to intelligently discuss the carbureter without referring to its relation in the functioning series that are responsible for the good performance of a motor. In a general way the relations of these functional devices may be looked upon as related to each other as follows:

(A) The carbureter must furnish the mixture to the motor in the right proportion of gasoline and air, free from liquid gasoline and ready to burn. This must be done without undue suction losses.

(B) The motor must be properly cooled in addition to being suitably designed from the point of view of the compression. In other words, the temperature of the combustion chamber must be maintained at a certain point, consistent with the requirement from the ignition points of view, but it must neither be above or below a certain set of temperature limits, it being the case that it is as much of a detriment to hold to a very low temperature as it is to try to operate at too high a temperature.

(C) The ignition system must be capable of delivering a spark of much energy at the proper time, the mere presence of a spark at the right time is not sufficient, the spark must have a very appreciable energy component.

(D) There must be an inherent ability in the carbureter such as will assure the right proportions of gasoline to air at all speeds of the motor so that (a) the power may be varied at a constant speed of the crankshaft, (b) the speed may be varied at a constant power delivery, or (c) the speed and power may be increased together and, of course, reduced simultaneously all within wide limits, and with a certain regularity, so that the flexibility of the motor will be pronounced.

(E) Weather conditions, that is to say atmospheric influences, must be compensated for; the operator must be placed in a position to regulate the speed and power of the motor at all times to suit the road condition, and the fact that the surrounding temperature is low or high, the humidity abnormal, or the air is saturated with water, should not alter the good performance of the motor.

(F) To be able to accelerate the motor from any speed is one of the requirements; it is also necessary to reduce speed from a very high to an equally low point at will, and the economy of the carbureter performance should be satisfactory under all these conditions.

(G) Safety is a factor; gasoline is a concentrated form of energy-bearing material, it is actually more powerful than the average grade of blasting dynamite; to handle this fuel with safety is certainly one of the many functions of the carbureter.

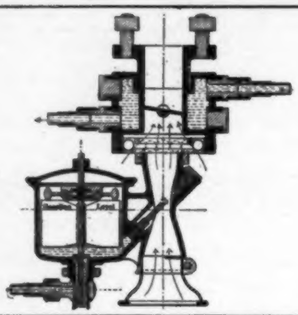
Gasoline is stored in a tank and it is piped from there to the carbureter, and then its flow to the motor is so regulated that for each unit of weight of gasoline that is allowed to enter the combustion chamber of the motor there will be a certain proportion of atmospheric air. As a general proposition it is desired to mix about 2 per cent. by weight of liquid gasoline with the air that is measured off by the piston displacement of the motor. Were the motor to be run at a constant speed and power, it would not be necessary to use a carbureter at all, due to the fact that the gasoline would then be required at a constant rate of flow, and this could be accomplished by the simple method of adjusting a valve so that the flow of gasoline, under a certain "head," would limit the flow of the liquid to that as demanded by the influex of air at a constant rate.

Practice does not sanction such simple, let us say, primitive methods, due to the fact that the speed of the motor changes continuously, and the power demanded to drive the automobile along the roadway depends upon the condition of the road, gradient and speed of the automobile. Moreover, it is true that the effect of wind resistance is a variable over broad ranges depending upon the speed that the car is making through the air which it cuts, and the extent of as well as the nature of the exposed surfaces of the automobile.

Under the circumstances it is necessary to regulate the flow of gasoline to accord with the requirements, and in nearly every make of carbureter this is accomplished by means of a float in a receiving bowl, into which the gasoline enters just as it is required, it being the case that the float, having the properly called buoyance, raises and lowers with the supply, and as gasoline is drawn out of the bowl the float lowers (with the needle of the valve) so that additional gasoline is permitted to enter the bowl to take the place of the fluid that is drawn out by the action of the motor. The force which acts to draw gasoline out of the flat bowl of the carbureter is called "suction"; in other words, the piston, as it recedes on the suction stroke creates a vacuum, and it is this vacuum that causes a depression around the nozzle of the carbureter, and the lifting power of the depression is sufficient to lift the gasoline up out of the orifice of the nozzle landing the liquid in the train of air that is drawn in by the same force.

Gasoline Must Be Vaporized Before It Will Burn

When gasoline is sucked out of the nozzle into the stream of air that is being taken into the combustion chamber of the motor it is in liquid form, and before it will form a mixture with the air that will burn and give up its energy the gasoline must be changed in its state of aggregation from liquid to the gas form. The process that brings about the change that is necessary is one of heating; that is to say, the gasoline must be boiled. As a simile, the boiling of water may be taken; when a kettle is placed upon a hot stove the water in it first heats up to 212 degrees Fahrenheit, assuming that the kettle is not so tight that the atmospheric pressure is excluded, and at this temperature the water, if heat is applied further in sufficient quantity, will boil; in other words, steam will be made. Gasoline boils in the same way, the only difference being that the boiling point of gasoline is lower than the same point of water. If the gasoline is of the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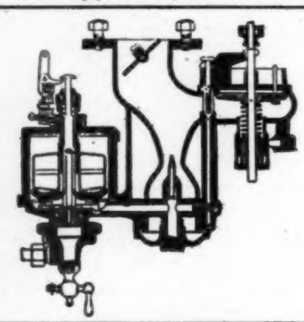
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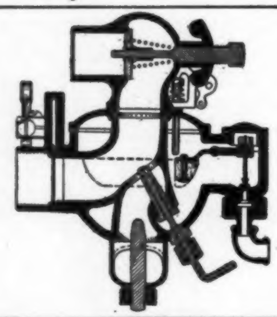
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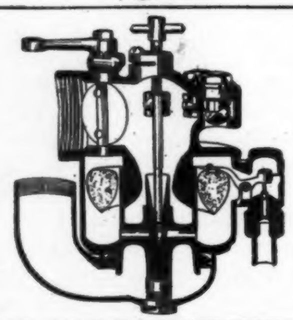
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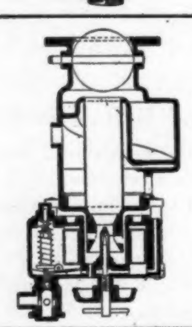
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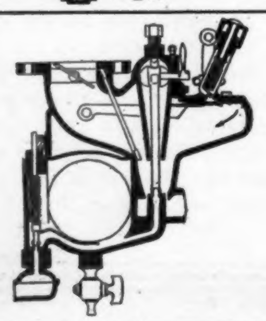
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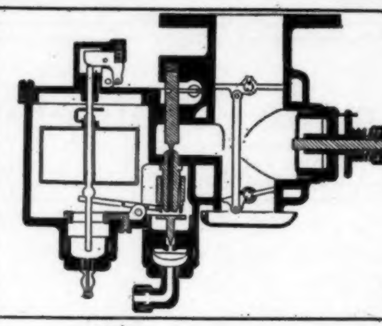
finest quality, as hexane, it will boil very readily indeed, but if it is composed of a series of hydrocarbons, as hexane, heptane, octane, nonane and decane, the boiling point will be raised and the amount of heat that will have to be applied at a given temperature will be much augmented, the exact difference will depend upon the proportions of the separate fractions in the composition.

Where does the heat come from? The heat that is required to boil the gasoline? From the air that is sucked in around the nozzle into which the gasoline is landed from the nozzle. Is there enough heat in the air to accomplish this function? Certainly! That is provided enough time is allowed for the purpose. The time required depends upon the temperature of the air, its state of the humidity and the voltaility of the gasoline; in other words, its boiling point, vapor tension and other characteristics.

It will be out of the question here to delve into the details of the characteristics of automobile gasoline, it being the case that the study of this product is complex and the space required for its elucidation will be sufficient to render it desirable to treat with it under a separate heading. In the meantime, holding to the subject, it remains to discuss some of the principles of carbureters on a more familiar basis if the reader is to be brought to a realization of the fact that carbureters, as they are made to-day, are so complex, notwithstanding an apparent simplicity, that they have to be made under the most exacting conditions by men who make a life's study of this special form of work.

It is self-evident that automatic action is desired; it goes without saying that the variations of power and speed of the motor, as they are demanded under operating conditions, should be met by suitable variations of the mixture in point of volume, but it cannot be shown that it is advantageous to alter the ratio of gasoline to air in the mixture from the point of view of thermal efficiency of the motor, since when the best rate of flame travel is reached by proportioning the percentage of gasoline in the air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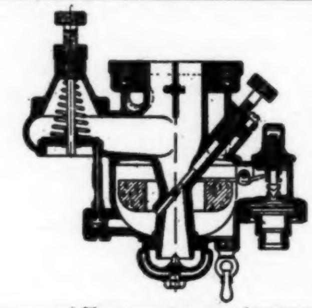
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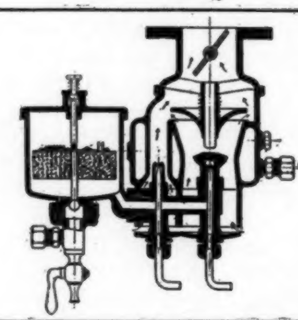
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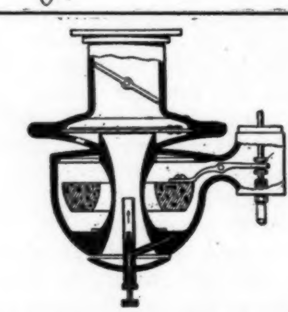
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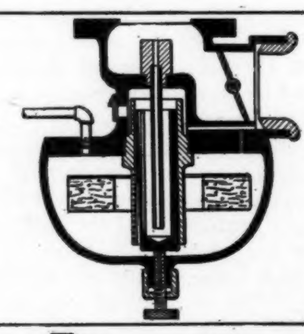
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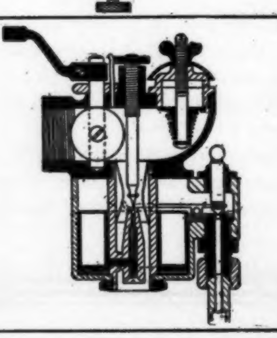
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A—G & A Carbureter with Inclined Jet
B—Stromberg Carbureter with Double Jet
C—Schebler Carbureter
D—Kingston Carbureter
E—Vortex Carbureter
F—Carter Carbureter
G—Rayfield Carbureter
H—Holley Carbureter
I—Willet Carbureter
J—Bowers Carbureter
K—Stewart Precision Carbureter
L—Breeze Carbureter

there is nothing more to be desired from this quarter, and the carbureter that is capable of maintaining this relation has just so many less variables to contend with and is so much the easier to maintain in a good state of utility considering a given expenditure of acumen on the part of the manipulator.

The Venturi tube, an invention by a physicist of the name, dating back to 1791, is accepted as the basis of all automatic carbureters, and it is this tube principle combined with various mechanisms that will be found in quite a number of the carbureters of the present time. The principle of the Venturi tube is represented when a pair of truncated cones are inverted and joined to each other, and in a carbureter it is the practice to terminate the nozzle at the point of joining, in other words, the junction of the two truncated cones. In Venturi's explanation of the action of his tube, he stated that the quantity of air that would pass in a given time under a given depression could be multiplied by four, as compared with a plain tube, provided the convergent angle of one of the cones is fixed as 30 degrees and the divergent angle of the remaining cone be fixed as 7 degrees. The quantity of air that is permitted to enter the convergence of 30 degrees is relatively great, and the effect of the 7 degrees divergence is well authenticated. One form of the Venturi tube principle is shown in Fig. A as it is applied to the G. & A. type of carbureter, which was originally brought out by Grouvelle & Arquembourg, of Paris, France, and handled in America by A. J. Myers, of New York City.

But it is not necessary to hold to a fixed angle of the convergent and divergent angles of the Venturi tubes; in fine, with other details adjusted to match, it seems to be good practice to modify the angles and in some instances, as experience has shown, most desirable effects are realized by means of tubes that are of special shapes with constrictions in the region of the nozzle orifice. These special shapes are determined by experiment, they seem to follow an undiscovered formula, and, with suitable provision in other respects, it is more than likely that the designer is permitted to depart widely from the practice of Venturi.

As an example of departure from the practice of Venturi, still holding to the idea of the constricting tube, reference may be had to Fig. B of a Stromberg type of carbureter as manufactured by the Stromberg Motor Devices Company, of Chicago, Ill. In this form of carbureter the Venturi effect is obtained in modified form by special shapes, which, according to the designers and borne out by tests, is quite in accord with the best expectations.

As another example of the application of the principle of the Venturi tube, reference may be had to the Schebler carbureter as shown in Fig. C, and, as a comparison will show, this carbureter differs in many important particulars from the other illustrations of the Venturi principle, thus bearing out the point that is being made, i. e.—If the shape of the tube is altered from that as originally outlined by the inventor Venturi, it is necessary to make other changes to compensate for the difference, but the advantage lies in accentuating some desirable point that may not have been possible of realization through the use of the simple form of tube of this generic type.

Conducting the investigation still further makes it necessary to examine other carbureters as the Kingston, as made by Byrne Kingston & Company, of Kokomo, Ind., as illustrated in Fig. D, in which it will be observed that the principle of the Venturi tube is utilized also in modified form. In this example the nozzle is concentrically related to the tube, and the orifice of the nozzle with a needle adjustment is located in juxtaposition to the point of maximum constriction of the modified Venturi tube.

With excellent force it will be possible to continue the discussion, calling attention to the presence of the principle of the Venturi tube in the Vortex carbureter, a section of which is shown in Fig. E, and in this example in addition to the Venturi effect there is also the influence of a generated vortex among other modifications that will have to be discussed from another point of view to bring out the relations.

Passing on now to other forms of carbureters it will be in order to take up with the Carter type of carbureter as shown in Fig. F, only to observe that while it is a distinctive design with important ramifications it is nevertheless the possessor of a marked Venturi effect, owing to the shaping of the depression chamber in the region of the nozzle orifice, which is in the concentric relation.

In the Rayfield type of carbureter as made by Findeisen & Kropf, of Chicago, Ill., it remains to observe that the depression occurs in a space around the nozzle (as shown in Fig. G) that bears no very clear outline to an old-fashioned Venturi, and yet the result is marked. In this example the construction is as follows:

Gasoline enters through the fitting, and its mate is filtered by the screen, and is stopped off by the needle, which has a German silver tip, engaging a suitably contrived seat. To stop the flow of gasoline, the float in the chamber, if properly set by the adjusting spring, will raise high enough to free the lever arm, thus permitting the part to which the tip of the needle is fastened to fall by its own weight so that the needle will seat. The nozzle is concentric with the dashpot-like member, and the gasoline is stopped off by the auxiliary needle, which is pressed to its seat by a spring, but is lifted off its seat by a bell crank which is controlled through a cam motion, operating when the damper travels a certain distance. Simultaneously with the lower damper the top damper travels, being actuated by the link, and as these dampers open air is admitted through the space above the rim of the catch-basin, filling the cavity. In starting the motor a small amount of air passes in through a fixed opening, which is shown by a dotted line surrounding the nozzle. This air sucks up enough gasoline to make a rich mixture, and this mixture passes into the chamber and through a slit in the damper. The operator, desiring to speed up the motor, alters the adjustment of the bottom damper, simultaneously lifting the auxiliary needle and the top damper. The result is a supply of mechanically established mixture, which under ordinary conditions will suffice for the purpose, and to this extent the carbureter is in accord with the best practice from the point of view of mechanically controlled carbureters of the auxiliary air type.

If, for any cause, the mixture becomes unbalanced, the differential compensating valve which is under the control of a spring, holding the valve to its seat, being supported at one end by the cap, with means for adjusting its tension by way of a threaded member, the valve will open and supply the requisite quantity of undiluted air to bring about a readjustment of the gasoline ration in the mixture, so that if the mechanical adjustment is such that the mixture is too rich, provided the speed of the motor is increasing, the valve will open and permit of the introduction of enough air to render the mixture sufficiently lean to do the most efficacious work.

But should the mixture be too lean, the speed of the motor will decrease, in which event the differential compensating valve will close automatically, and by doing so bring about a condition of enriching of the mixture, with the result that the speed of the motor will become stable, and the power will be that which should obtain when the mixture is exactly right in view of all the operating conditions.

In each of the other carbureters shown in Figs. H, I, J and L the principle of the Venturi tube is carried out in slightly modified forms. This tube is sometimes inserted as a separate part of the carbureter and the makers can supply on demand different angle tubes called choke tubes, thereby allowing the maker of the engine an opportunity of experimenting.

THE AUTOMOBILE

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MAKERS of automobiles are experiencing another revolution brought about by adverse action of the Court in the matter of the Selden suit, the ramifications of which are so diversified that there are probably not more than four or five men now living who would be able to express a competent opinion of the scope and far-reaching effect of this legal contest with its thousands of pages of testimony and hundreds of conflicting opinions emanating from the most competent sources, covering all phases of the automobile industry, with special reference to the crude state of the art at the time of the issue of the Selden patent. The full text of the United States Circuit Court of Appeals, Second Circuit, is given in THE AUTOMOBILE, accompanied by abstracts from the testimony of Dugald Clerk and abstracts from the arguments of the legal luminaries who fought on both sides and, as will be appreciated, there is nothing to be gained by trying to elucidate the opinion of the Court, nor is it possible at this time to make any prediction as to the outcome.

* * *

"LET US HAVE PEACE." When Grant had Lee in the throes of defeat in front of Richmond, and the Union Army was equipped for any eventuality, the greatest strife the world had ever known was relegated to the musty pages of history and the future took on its customary rosy hue in response to the meaning conveyed in the simple dictum as here reiterated. The battles that the Union Army fought to victory and the engagements that brought out the splendid genius of Lee, now rest in the shadow of the great light that shines as the beacon of the mariners for all time, and the simplicity of the language and the kindly nature of its portent should appeal just now to the victors and the victorious, for there are none who will claim defeat. It is the fair contention of those who fight in the Selden ranks that they stand for stability in the automobile art, that they wish to maintain a high standard of the industry, and they importune the reckless and those who are seated in over-ambition's chariot to partake of wisdom and to be guided by prudence. But the men who are struggling on the other side are noted for their acumen also, and they stoutly maintain that they stand for exactly the same fixed set of desirable conditions.

* * *

WHILE the principals in this grand drama are thus engaged the world looks on, and the part of it which stands for strife and turmoil is in an inquiring state of mind, impelled by an overpowering curiosity, rent by the fear that there will be an end to the imposing spectacle. But the time arrives in the career of men when their good sense tells them that an accumulation of rust is the best adornment for their "flint-locks," leaving it for those who have the inclination to fashion a pincushion out of the powder-horn, while the men go back to the plow. It is impossible to conceive of a set of men of the class who can lay claim to the high order of intelligence that passes current among the builders of automobiles who would be so short-sighted as to forget the object of their work, and to reduce themselves to the pitiable state which is the most striking characteristic of the giant when he is down.

* * *

CO-OPERATION, to whatever extent it will help the builders of automobiles to make better cars and to bring a return to the investors on the one hand and satisfaction to users of automobiles on the other, is the best doctrine that can be applied to a sore situation at the present time. A wise man said: "Were we to change places for twenty minutes, there would never be any more cause for controversy." But in shifting about for the purpose of acquiring experience, let it not be forgotten that a part of the time should be expended in the capacity as "a patron of the industry," if for no other purpose, in order that utility needs shall not be overlooked. Every single unit of time that is preëmpted for no better purpose than to disagree upon any subject, detracts from the ability of the participant in the disagreement and lowers the standard of value of the work done under such conditions. It is a great misfortune, too, that those who look up to the great captains of the industry who are devoting their lives to the building of automobiles, should be permitted to witness the sad bickerings as if the prize were some inanimate thing to be bagged as spoils. "Let us have peace."

S. A. E. Elects Officers

HENRY SOUTHER, STEEL EXPERT, CHOSEN PRESIDENT OF THE SOCIETY TO SUCCEED HOWARD E. COFFIN—RECORD-BREAKING ATTENDANCE MARKS OPENING OF ANNUAL MEETING

WHEN President Howard E. Coffin of the Society of Automobile Engineers called the annual meeting of that body to order Wednesday morning in Assembly Hall of the Automobile Club of America, there were present an unusually large number of the members of the society.

The chief work of the morning session was the election of officers and Henry Souther was selected to carry on the great work accomplished and outlined by Mr. Coffin.

Howard Marmon, of the Nordyke-Marmon Company, Henry May and Charles E. Davis were chosen managers of the society for a two-year term. A. H. Whiting was re-elected treasurer.

The amendments to the constitution of the society which had been introduced some time ago were submitted to the meeting and after discussion were advanced to the stage where they will be presented to the membership for a mail vote.

The first working session of the order was held during the afternoon and in the evening the society assembled in annual banquet, which was spread in the rooms of the A. C. A.

The menu of the annual dinner was done in unique and amusing form. As will be seen by the accompanying illustration, it was in the shape of a gastro-manograph with plotted curves showing the rise of enthusiasm with relation to passage of time, which was not noticed going by.

Palace Show Ends; New Makers' Body

AFTER a week marked by satisfactory attendance and a large volume of business, the Palace show is a matter of history. While the gate receipts did not equal those of last year's show by a small margin, the crowds as a whole were larger and the general comment on the affair by exhibitors was favorable.

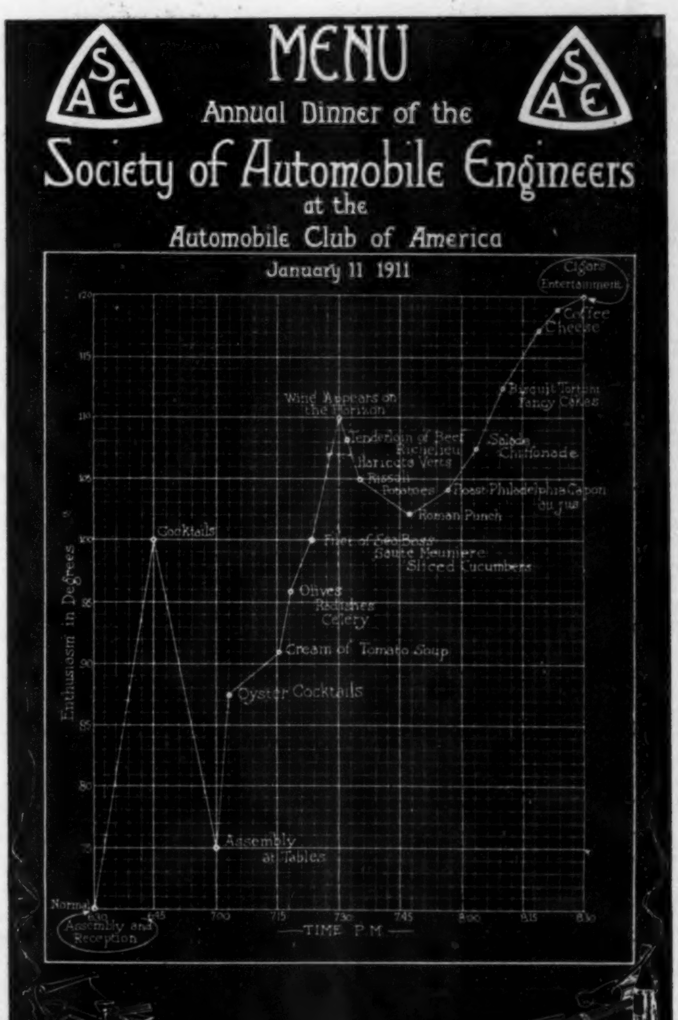
Various exhibitors expressed themselves as being dissatisfied with the private administration and promotion of the show and it was freely announced that future events of the kind would be held only under the auspices of some organization of makers.

In fact the idea of an organization of this kind has been agitated for several months and during the final days of the exhibition, about thirty of the manufacturers got together and formed a preliminary body.

At a luncheon held at the Hotel Manhattan the plan was announced and subsequently the following directors of the new corporation were chosen: Carl F. Johnson, Johnson Service Company of Milwaukee; W. S. Jones, Otto Motor Car Sales Company of New York; Thomas Aldcorn, Chicago Pneumatic Tool Company; W. J. Mills, H. H. Babcock Company, Watertown, N. Y.; Col. T. A. Campbell, Imperial Automobile Company, Jackson, Mich.; Louis J. Bergdoll, L. J. Bergdoll Motor Car Company, of Philadelphia; H. C. McFarlan, McFarlan Motor Car Company, Connersville, Ind.; C. W. Kelsey, C. W. Kelsey Mfg. Co., Hartford; E. W. Hommel, Clark-Norwalk Motor Car Company; S. E. Baily, B. C. K. Motor Car Company; Counsel, Frank H. Field.

As the result of a meeting which was held on January 10 at the Hotel Manhattan, the baby association was given its official name, and officers were elected with Col. Theodore A. Campbell of the Imperial Automobile Company, Jackson, Mich., as the president. The first vice-president is William S. Jones of the Otto Gas Engine Company of Philadelphia, Pa.; second vice-president, Prof. Warren S. Johnson of the Johnson Service Corporation, Milwaukee, Wis.; treasurer, William J. Mills, of the H. H. Babcock Company, Watertown, N. Y.; assistant treasurer, Carl F. Johnson, of the Johnson Service Company, Milwaukee; secretary, C. W. Kelsey of the C. W. Kelsey Mfg. Company, Hartford, Conn.; assistant secretary, J. L. Robinson, New York City; executive committee, Messrs. Campbell, Carl Johnson, Kelsey, Jones, and Louis J. Bergdoll, the latter of the Louis J. Bergdoll Motor Car Company, Philadelphia, Pa.

It will be remembered that Herbert Longendyke managed the show at the Grand Central Palace with great success this year, and after some persuasion he agreed to retire from the Journal Company of Troy, N. Y., and to take up the general management of the new association. It is announced that the primary object of the A. M. A. A. is to foster a better understanding in the ranks of its associates, and to set a good example from the point of view of fair competition.



Record Crowds at Garden

ELEVENTH NATIONAL AUTOMOBILE SHOW ATTRACTS VAST ATTENDANCE AT EACH SESSION, FILLING AISLES AND GALLERIES—LIST OF ACCESSORY EXHIBITORS

WITH aisles and balconies crowded to their capacity at every session, the Eleventh National Automobile Show, under the auspices of the A. L. A. M., at Madison Square Garden, has proved a remarkable success from every point of view so far. The cars, which were treated exhaustively in THE AUTOMOBILE last week, are attracting an immense amount of attention, and much business is reported in every direction.

Much more interest is being displayed this year in the accessory exhibits than ever before and the spectators had to move slowly in passing some of the more attractive booths on account of the press of the public.

ing its B. & S. Igniter, operated from the dash by either hand or foot, and claimed to be absolutely heat-, oil- and water-proof.

Castle Lamp Co.—At space No. 181 this company sets forth a most comprehensive exhibit of its 1911 line of Castle lamps for pleasure cars and commercial vehicles.

Champion Igniter Company—The Koehler Headlight Igniter, a device designed to do away with lighting troubles is the feature of the display in space 400.

Culver-Stearns Mfg. Co.—C-S electric lighting specialties for automobiles and motor boats form the exhibit of this company at stand No. 404. The C-S Hold-Fast Connector is one of the specialties.

FIG. 1—OPENING NIGHT LOOKING DOWN UPON THE ASSEMBLAGE FROM THE GALLERY

Following is as complete a list of the accessory exhibits of all kinds as could be compiled:

Lamps, Ignition Devices, Etc.

Apple Electric Co.—In addition to this company's comprehensive line of dynamos, lamps, storage batteries and fixtures, the new "Aplco" automobile dynamo is being demonstrated at space No. 239.

Auto Supply Mfg. Co.—Among other things that made up the exhibit of this concern at stand No. 618 was the Simplicity Rectifier, for charging ignition batteries from an alternating current. It is equipped with a transformer and ammeter.

B. & L. Auto Lamp Manufacturing Company—Lamps of a score of types are shown in space 575. Those on display include flare headlights, de Luxe, gas headlights, torpedo lamps of several styles, oil-tail lights and a line of electric lamps,

Badger Brass Mfg. Co.—Solar lamps for automobiles, in all sizes and shapes—head, side and tail—form this exhibit, which is handsomely installed in space No. 126.

Briggs & Stratton Co.—At space No. 269 this firm is show-

R. E. Dietz Co.—At this company's exhibit, at space No. 189 are shown a full line of Victor and Majestic headlights, numerous varieties of side and tail lamps and generators.

Edmunds & Jones Mfg. Co.—At space No. 157 this concern is exhibiting its beautiful line of new design acetylene and electric headlights with removable mirrors. A line of combination electric and oil side and tail lamps is also shown, in addition to a new model acetylene generator.

Electric Storage Battery Co.—The "Ironclad-Exide" electrical vehicle battery features the exhibit of the above-named company at space No. 227. It is the result of four years' experimentation, and is designed to prevent loss of active material.

Elliott Auto-Lighter Co.—At booth No. 594 this concern is exhibiting the working of this latter-day convenience for ease-loving automobilists, which enables the driver to start his acetylene lamps without leaving his seat or stopping the car.

Geiszler Bros. Storage Battery Co.—At space No. 513 this company is showing a complete self-regulating ignition and lighting outfit, besides its line of non-sulphating ignition and lighting types of storage bateries.

Accessories

FIG. 2—GENERAL VIEW OF MAIN HALL AS SEEN FROM THE ELEVATED PLATFORM

Gray & Davis—The display of this concern, at booth No. 130 includes an exposition of the de luxe system of car lighting from the generation of the current to its delivery to the various beautiful lamps which make up the company's complete line.

Hofacker Manufacturing Company—The "Daysee" tail lamp is one of the interesting things shown by this New York concern in space 532. The lamp is 12 inches high with bail and is fitted with ruby semaphore and white optical lens.

J. H. Lehman Mfg. Co.—At the booth of this company, No. 159, is being exhibited the L-H-L Ignition System, by means of which a low-tension jump spark is obtained by a simple combination of high-frequency and low-tension currents.

Luce Manufacturing Company—An attachment for automobiles that automatically shifts one of the searchlights in making a turn is the feature of the display in space 553a.

Meteor Gas Company of New York—Gas tanks for use on the automobile are displayed in the exhibit of this company, space 578.

Motor Specialties Co.— The "Flash Auto-Lighter," a simple, dependable device for automatically lighting or extinguishing acetylene headlights from the driver's seat, featured the exhibit of this firm at space No. 425.

National Carbon Company—Columbia multiple batteries for cylinder ignition, auxiliary service or continuous running are shown in space 133. The company's factory is at Cleveland, O.

Northeast Electric Company—Electric lighting for automobiles is the leader of the exhibit of this Rochester, N. Y., company in space 518.

Fred Robinson—Tail lights for lighting the license number according to law are the special feature of the exhibit in space

FIG. 3—GENERAL VIEW OF THE SHOW FROM ANOTHER ASPECT

Fig. 4—Brush and Sampson models shown at the same booth—where the Abernathy "kids" are much in evidence

Fig. 5—Marmon exhibit with Model 32 in the background and "trophies" of the year in the foreground

559. The trade name of "Sure Number" has been given this line.

Rushmore Dynamo Works—This company is featuring an automatic shaking grate generator in space 418; a device for producing acetylene gas from calcium carbide and water.

Scheu-Dexter Manufacturing Company—A device for controlling the headlights is the chief exhibit of this company in space 517.

Vesta Accumulator Co.—This company is exhibiting, at booth No. 233 its standard line of sparking and lighting batteries, besides a complete line of electric automobile lamps of all kinds.

Ward Leonard Electric Co.—This concern's exhibit, at space No. 573, is devoted to an exposition of the Ward Leonard automatic dynamo lighting system.

Witherbee Igniter Company—At space No. 277 this concern is showing a broad line of ignition and illuminating devices, comprising storage batteries, spark generators, timers, spark plugs, switches, trouble lamps, reflectors and other equipment for the conversion of oil and gas lamps for the use of electricity. Fifteen types of storage batteries are shown. A feature is the Witherbee Special Lighting Battery.

Lubricants and Fuels

S. F. Bowser & Co., Inc.—Safety in the storage and use of gasoline for automobiling is demonstrated in all its details at the exhibit of this company at stand No. 191. Underground tanks, pumps, safety filling devices and all the other garage equipment that makes for safety in the handling of volatile and highly inflammable liquids is shown.

Bliven & Carrington, Inc.—"Champion" and "E-Z-Way" lubricants are shown by this Philadelphia concern, both of which are highly recommended by the company for use on automobiles. The space number of the company is 534.

Columbia Lubricants Company—The leader in the exhibit of this company is the "Monogram" line, including several grades of cylinder oil. The company is located at 116 Broad street, New York. Its space number is 223.

Adam Cook Sons—Greases are the chief item of the exhibit of this company in space 157a. The company's factory is situated above Albany, N. Y.

J. Dixon Crucible Company—"Motor Graphite" for cylinder, gear and clutch lubrication in connection with oil and "Dixon 688" a graphited wood grease for enclosed transmissions, constitute the leaders in space 182.

A. W. Harris Oil Company—"Harris Oils" of various grades and kinds are shown in space 162. The company is located at Providence, R. I., and specializes on cylinder oils for automobiles.

Havoline Oil Company—In space 303, the "Havoline" line of lubricants, comprising a full line of cylinder oils and motor lubricants, is shown. The company is situated at 133 William street, New York.

George A. Haws—"Panhard" oil for automobile cylinders is the leader in the exhibit of this concern in space 260. Head-

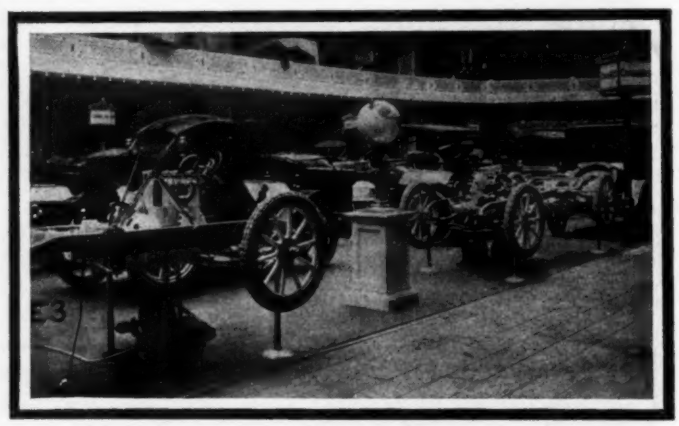


Fig. 6—Chalmers exhibit, showing the "30" and "40," also the Glidden trophy

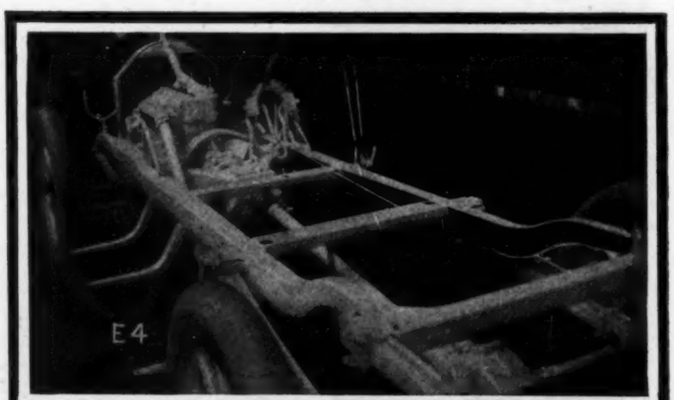


Fig. 7—Hudson exhibit, with the "33" chassis painted white as the center of attraction

quarters and general offices are at 62 Pine street, New York City.

The R. M. Hollingshead Company—The "Whiz" oils, greases and specialties are the feature of the display in space 512. The Hollingshead Company has its factory and headquarters at Camden, N. J.

Hydraulic Oil Storage Company—Storage tanks for gasoline which are recommended by their makers to be air tight, without evaporation and which serve to purify the gasoline contained are shown in space 507.

Keystone Lubricating Company—Light and heavy greases for friction surfaces on automobiles are shown by this Philadelphia company in space 612.

William P. Miller's Sons—"Excelsior," a fibrous oil for motor lubrication and "Pan-O-Lite," a cylinder oil, are the principal displays in space 565. The company is located at 244 Greene street, Brooklyn.

N. Y. and N. J. Lubricants Company—"Motorol" is the leader of the exhibit of this company, which is showing a full line of its product in spacĕ 185. The company recommends "Motorol" for use in cylinder lubrication. Its headquarters are at 165 Broadway.

Philadelphia Grease Manufacturing Company—Automobile lubricants manufactured at the Philadelphia factory of this company are shown in space 521.

L. Sonneborn Sons—The "Amalie" brand of motor lubricants, including light and heavy motor oils, greases, bodypolishes, etc., is displayed in space 524. The offices of the company are at Fulton and Pearl streets, New York.

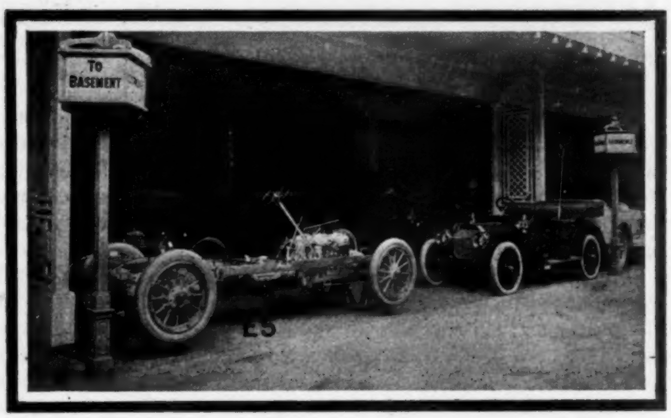


Fig. 8—Locomobile exhibition, with the new Model M six-cylinder motor as the feature

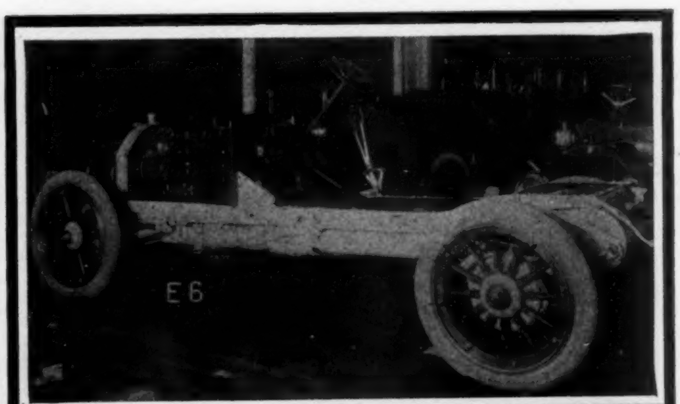


Fig. 9—Matheson exhibit, with the six-cylinder model attracting the notice of its friends.

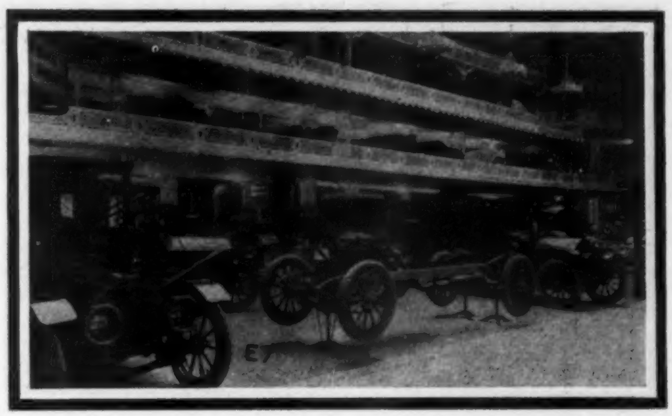


Fig. 10—Pierce-Arrow exhibit, showing the six-cylinder models and a fine line of body work, including the George Washington coach

Fig. 11—Winton exhibit, with sixes only, and a torpedo body that is one of the features of the show

The Atlantic Refining Company—This company, whose home is in Cleveland, Ohio, displays "Arco Spotzoff," a metal polish, and other specialties of a similar character in space 318.

Vacuum Oil Company—"Mobiloil" of all grades, the leader of this company's product used for automobile lubrication, will be featured in space 185. The works of the Vacuum company are situated at Rochester, N. Y.

Motor Parts Company—Automobile wrenches, manufactured by the Frank Mossberg Company of Attleboro, Mass., are on display in space 402. The Auto Cle and Titus Cle are the features of the exhibit.

Wayne Oil Tank and Pump Co.—Measuring pumps and storage tanks for the proper handling of gasoline and lubricating oils comprises the exhibit of this company at space No. 544. The desired quantity of liquid can be obtained at a stroke of the handle without the use of the old time measure. There is no loss from evaporation, and no chance for theft, besides which fire insurance rates are reduced to the minimum.

White & Bagley Company—"Oilzum" the feature product of this company, and the other affiliated products are shown in space 316. The company is located at Worcester, Mass.

Orlando W. Young—This Newark concern occupies space 293 at the Garden show. A line of lubricants and specialties is featured.

Metals and Forgings

Delcampe Welding Company—Welding one metal to another in workmanlike shape has always been a problem difficult

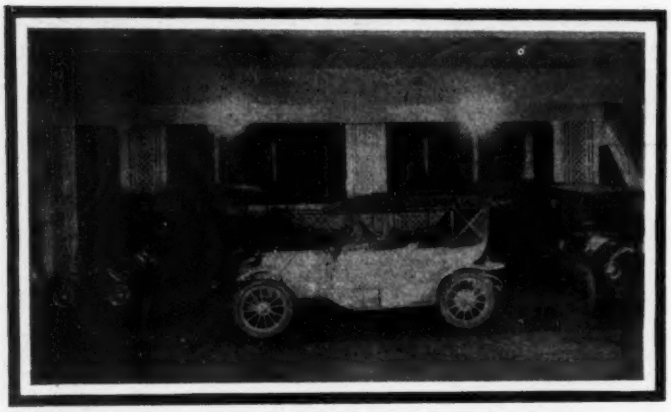


Fig. 12—Thomas exhibit, with Model M as the main feature—the "torpedo" in the center is a great attraction

to solve by the mechanic. The company that shows in space 535 claims to have such a system in operation. By means of it the company states that various metals may be welded together in close association. The company also handles tools, etc.

Doehler Die-Casting Company—Castings for many purposes of automobile manufacture are shown by this Brooklyn company in space 263. Various alloys are used in the manufacture of this line and the exhibit is comprehensive enough to prove interesting.

Driggs-Seabury Ordnance Corporation—At stand No. 253 this concern is showing samples of its drop-forged pressed steel, hammer-forged, machined and ground parts of all descriptions.

H. H. Franklin Manufacturing Company—The makers of

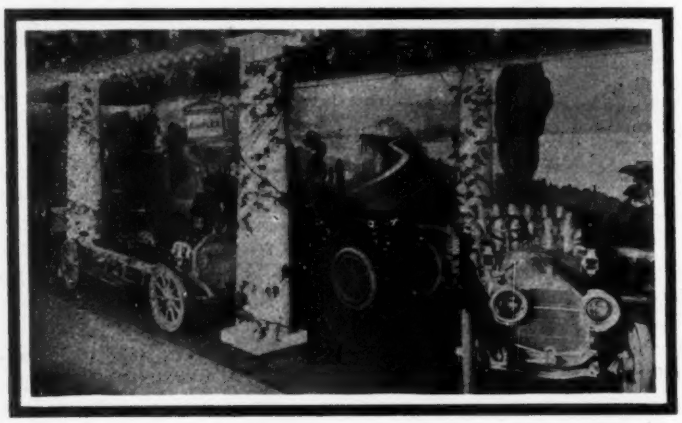


Fig. 13—Amplex exhibit, presenting a line of two-cycle motors and other attractions

the Franklin automobile are also displaying a line of die castings in space 569 of the accessory exhibit. This line embraces about everything of the kind used in automobile building. The claim is made by the company that parts turned out are ready for use without machining.

Peter A. Frasse & Co., importers of metals, show in space 564. Among the exhibits in this booth is a line of Poldi steels for high-speed tools used in turning, planing, slotting and milling.

Globe Machine and Stamping Co.—Steel tool and battery boxes for automobiles are shown at space No. 274 by this company.

Gotham Aluminum Solder Company—Space 553 among the Garden accessory exhibits is devoted to the display of the wares of this company. The company makes a specialty of all kinds of repairs involving aluminum.

International Engineering Company—Imported steels of various kinds make up the exhibit of this company in space 601. Aside from R. B. F. ball bearings the company shows double acting thrust bearings, limit gauges, thrust cages and numerous other steel devices.

Isaac G. Johnson & Co.—Steel castings are shown by this company in space 287. The product of the company's plant at Spuyten Duyvil, New York City, is used to a considerable extent in automobile manufacture. The line consists of almost every part of the car for which steel castings can be used.

Lebanon Steel Casting Co.—This concern is exhibiting, at space No. 237, axle castings made by a process used extensively abroad. A complete line of vanadium castings of which the company is making a specialty, and its regular crucible steel castings are also shown.

Fig. 14—Packard exhibit, presenting fore-door models and regular Packard motor work. The single-door limousine is shown

Light Mfg. and Foundry Co.—At space No. 134 this company is showing automobile brand aluminum castings, especially adapted to automobile, autoboat and electrical work; automobile brand manganese bronze, phosphor bronze, plastic bronze and bearing metals, and Babbitts, especially adapted to the several uses to which Babbitts are used in the trade.

Philadelphia Steel and Forge Company—Natural alloy steel for motor car construction from the plant of this company at Tacony, near Philadelphia, is shown in space 412. This substance is used also for the making of die blocks, trimmers, etc.

Thomas Prosser & Son—This firm of steel importers is showing at booth No. 599 various qualities of Krupp steel for automobile purposes, including round forged bars of chrome nickel steel, grade E F 60.0.

Fig. 15—Stearns exhibit, including the 15-30 and other models, also some fine features in body work

Reinhold Noflux Aluminum Solder Company is exhibiting at space 426. The chief item of this display is a line of solders designed especially to join two pieces of aluminum without the use of a flux. The idea has had practical form since 1908. The company recommends it for strength, simplicity and smoothness.

A. O. Smith Company—At space No. 137 this firm is showing samples of its pressed steel automobile frames of a high standard of workmanship.

The American Vanadium Company—This Pittsburgh concern is showing alloys used in automobile manufacture in spaces 312 and 321. In the first-named space the display is of alloys for steel and in the other alloys for brass are featured. The use of vanadium and other alloys has grown to such an extent in motor car making that the exhibit of it at shows always attracts much attention.

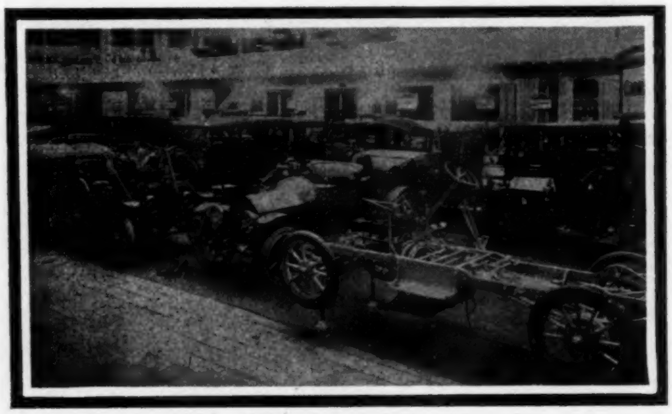


Fig. 16—Cadillac exhibit, including the chassis, which is sectioned and running to show patrons how well it works

The Carpenter Steel Company—All kinds of steel for the use of automobile makers is produced by this company and samples are on display in space 276. The line consists of Chrome-nickel, chrome, chrome-vanadium, nickel, silico-manganese and carbon steels of numerous grades. Crucible Chrome-nickel steel is featured.

The Crucible Steel Company has space 285. Steel alloyed for special use in automobile making is the feature of its line on display. These products, now regarded as so vital to the industry require the utmost of scientific nicety in their composition and the exhibit of this company is of particular interest to both owners and makers of cars.

The Cupror Company—A golden metal, for which it is

Fig. 17—Lambert exhibit of friction drive automobiles and a special line of body work

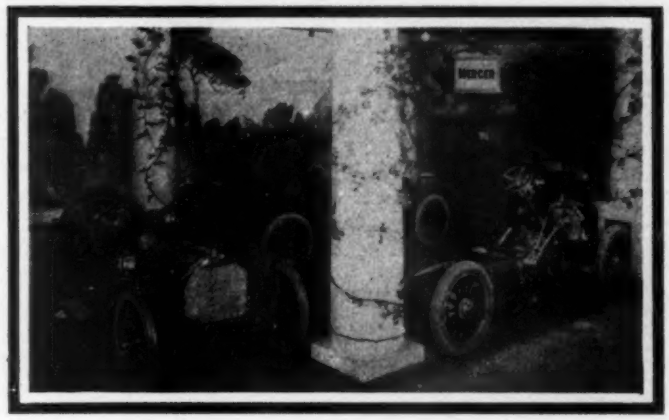


Fig. 18—Mercer exhibit in the main hall, with a chassis and a runabout in an attractive setting

claimed that it will resist the action of acids and is not corrodable, is shown by this concern in space 318.

The Standard Welding Co.—At space 176 this concern is showing Standard Clincher, Quick Detachable and Universal Q. D. Demountable rims; also an exhibit of the company's work along the line of electric welding and in furnishing automobile bent parts formed from standard seamless steel tubing.

United Steel Co.—Chrome vanadium steel and vanadium (anti-fatigue) steel, for use in automobile construction, is shown at the exhibit of the above-named company at space No. 320.

E. B. Van Wagner Mfg. Co.—This concern is showing at stand No. 262 a comprehensive line of Van Wagner die castings.

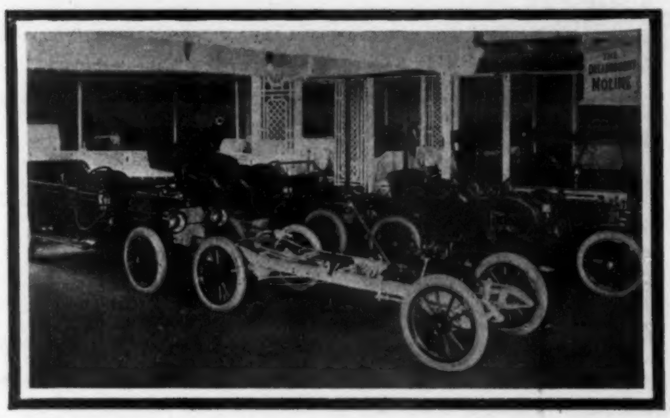


Fig. 19—Dreadnaught Moline alongside of the Premier exhibit under favorable auspices. The Premier 4-40 is shown in the foreground

Motors and Parts

Columbia Bolt and Nut Company of Bridgeport, Conn., is showing in space 154. The feature of the line is the Columbia Lock Nut, which is a combination of three mechanical powers in two parts. These are the wedge, screw and lever, the wedge being several times compounded and the device locking automatically.

William Cramp & Sons Ship and Engine Building Company—A full line of automobile castings is displayed by the Cramp company in space 187. The line includes bearing metals, white brass, phosphor bronze, Parsons manganese bronze axles, gear cases, steering gears, transmission cases and miscellaneous castings of many sorts.

El Arco Radiator Company—Showing in space 577, this company, which was formerly known as the Livingston Radiator

Company, is exhibiting an extensive line of radiators. The concern makes only a honeycomb, square cell device with wide water passages. These radiators are stock equipment on many well known makes of cars.

Excelsior Motor and Manufacturing Company—This company is showing its 1911 power plant for pleasure cars and trucks. It follows the lines of French construction. It is four-cylinder, four-cycle type, with 4 1-8 bore by 5 1-4 stroke and is rated as a "40."

Frost Gear and Tool Machine Company—A line of improved transmissions, axles and differentials, is shown in the space of this concern, number 309. The company does custom work in addition to its regular line of manufacture.

S. Hoffnung & Co., Ltd.—The company is showing the Coventry chains, an English product, in space 585. The line is quite full and is attracting considerable attention.

Keystone Steel Castings Company—Space 503 is occupied by the exhibit of this company. It consists of an exhaustive display of castings used in automobile construction, ranging from the largest and heaviest pieces to the most minute. The company is located at Chester, Pa.

Lebanon Steel Casting Company—Castings used largely in automobile manufacture make up the exhibit of this company in space 237. The company claims to furnish parts to fifty-four automobile makers.

Lefever Arms Company—Transmissions, gears, clutches, brake bands, bearings, differentials, cases and other automobile parts, make up the display of this company in space 543a.

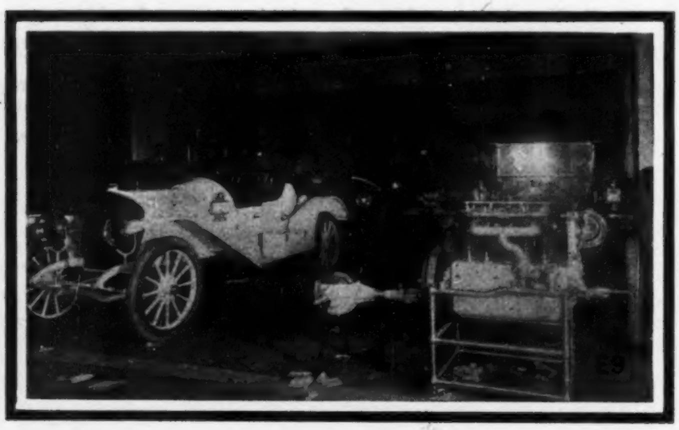


Fig. 20—National exhibit with a fore-door model and a motor to interest the many

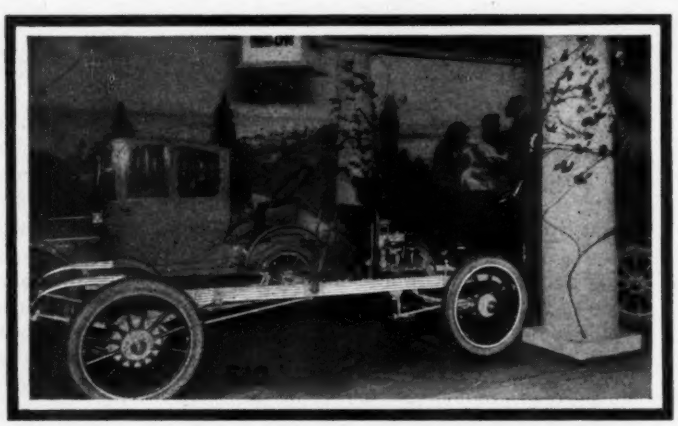


Fig. 21—Moon exhibition, showing a stripped chassis flanked by an enclosed model of Moon car

McCord Manufacturing Company—The McCord radiator is the leader in the display of this company in space 325. This radiator is of the vertical tube type with continuous horizontal fins. The tubes are of brass, one-quarter inch in diameter. Aside from the radiator the company is showing force-feed lubricators, gaskets, fans, belting and brass castings.

Manufacturers' Foundry Company.—Cylinder castings are the feature of the exhibit of this company at space 279. The company makes a specialty of turning out cylinders for all sorts of automobiles. Both water and air-cooled engines, motor-cycles, motor boats and aeroplanes are fitted with these cylinders. Pistons, piston-rings and other parts are also made.

National Tube Company is showing a line of seamless tubing for mechanical purposes in space 133. The company is featuring the Shelby Cold Drawn Seamless steel tubing which is widely used in automobile construction.

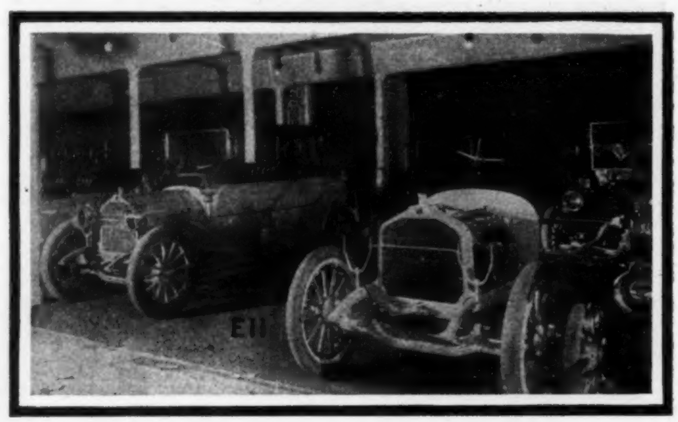


Fig. 22—Selden exhibit, presenting three models, one of which is stripped to expose the machinery

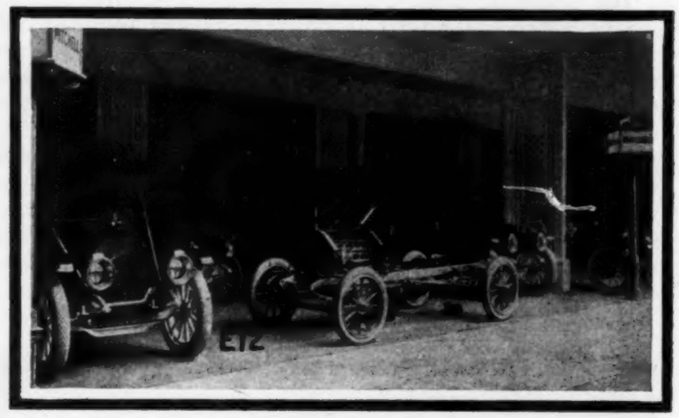


Fig. 23—Mitchell exhibit under the eves of the gallery, with a chassis and several models

Parker Motor Company—This concern is showing a four-cylinder, four-cycle motor, made in Hartford, Conn., in space 283. The A. L. A. M. rating of the motor is 32.4 horsepower and its bore is 4 1-2 by 5 inches. The cylinders are cast in pairs, offset one inch, with long connecting rods to provide low speed under heavy load. The cylinders are of the L type.

Perfection Spring Company—Space 541 is occupied by this company's exhibit of springs. Both pleasure and commercial car equipment is handled, the line including semi-elliptic, three-point suspension, full elliptic and other shapes and sizes.

Russel Motor Axle Company—This Detroit company is showing in space 288 and has on display several types of rear

axles. The completed parts and each element that goes to make up this important factor of the automobile are exhibited.

Simonds Manufacturing Company—Motor clutch discs, files, saws for cutting metals are shown in the exhibit of this concern in space 598. The company specializes in tools of all sorts and the display includes many items not specifically mentioned.

Sparks-Withington Company—While a line of radiator fans is the leading feature of this exhibit at space No. 308, the company showing them also makes hubs, brake-drums, cone-type ball bearings and other pressed metal products.

Stevens & Co.—A miscellaneous line of automobile parts,

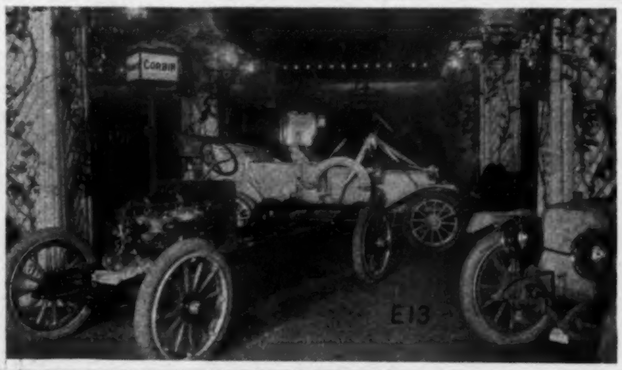


Fig. 24—Corbin exhibit in exhibition hall in a setting that is attracting marked attention

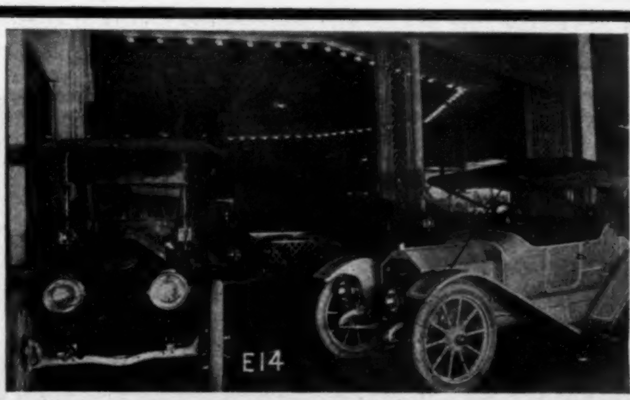


Fig. 25—Pullman exhibit, with a fore-door body for two that is the feature, according to spectators

including valves, gauges, pumps and lighting specialties, is shown in space 520. The company is located in New York City.

The A-Z Company—Automobile parts built of sheet metal constitute the exhibit of this New York company in space 597. The line includes radiators, which are used on several high-class automobiles, three-hinge hoods, mud guards on fenders, manifolds and numerous other parts.

The Brown-Lipe Gear Company—This concern is showing transmissions, gears and differentials in its space, number 170. The company has its factory at Syracuse, N. Y.

The Harrison Radiator Company, a newcomer in the field, is showing its radiator in space 607. It is of simple construction with cooling surface equal to a honeycomb radiator of similar size, despite the fact that it is of tubular construction.

The Muncie Wheel Company, makers of the Bannister wheel, have space 284. The manufacture of automobile wheels

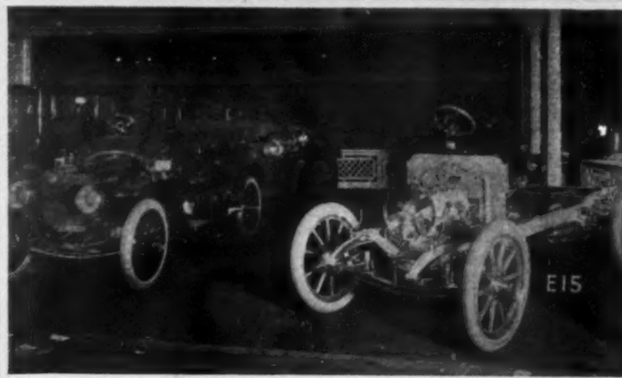


Fig. 26—White exhibit, presenting gas cars, a polished chassis, torpedo model and much of interest

Fig. 27—Lozier exhibit, with several models, including a limousine, torpedo and a stripped chassis

is a new line to the company, but since the completion of the new factory, it has gone into this line rather extensively.

The McCue Company—Automobile axles are shown by this company in space 282. The company's factory is at Hartford, Conn. The line includes axles of various sizes and types and goes in for custom work on a large scale.

The Sheldon Axle Company has space 617. The company makes axles and springs for motor-propelled vehicles as well as other products. Its axles are the feature of the exhibit, the company manufacturing a number of standard sizes and accepting business on order to be made up from privately submitted blueprints and specifications.

The Tuttle Motor Company is showing a two-cycle engine in space 608. The feature of the engine is the rotary intake valve by means of which the advantages of both the two and three port systems are combined. The valve is timed so as to hold open intake port until a full charge has been drawn into the base.

Warner Manufacturing Company is showing in space No. 247 a unit power plant, motor four-cylinder, 3 1-2 x 4 3-4, complete with cone clutch, three-speed and reverse selective sliding transmission; also jackshafts, including the transmission unit both in sliding gear type and the planetary type, suitable for 1,500 to 3,000 pound commercial cars.

American Ball Bearing Co.—This concern is showing at space No. 177 its line of I-section front axles, live rear axles and a line of ball bearings.

Baldwin Chain Mfg. Co.—At space 135 this company is showing the Brown Steering Gear, in which all the surfaces

Fig. 28—Goodyear tires, Whitney chains, Veeder speedometers, with a new distance recorder for the hub of the wheel

subjected to wear are large and operated in oil, thus eliminating all back-lash or wear.

Barthel, Daly & Miller.—The full line of Schafer ball bearings is being shown in the exhibit of this company at space No. 584.

Briscoe Mfg. Co.—At space No. 186 this company is exhibing its new type of radiator consisting of a vertical tube with square or Mercedes effect of front. The Briscoe improved square-tube radiator and the Detroit honeycomb rediator, the latter especially adapted to motor trucks, are also being shown.

Calmon Asbestos & Rubber Works of America—At space 415b this company is showing its line of asbestos brake linings, clutch facings and gaskets.

Diamond Chain & Mfg. Co.—These chains, housed in dust-proof, oil-tight cases, are now being used by a number of well-known automobile makers.

Fedders Mfg. Works.—At the exhibit of this company, located at stand No. 539, was given an exposition of the Fedders truck radiator, with an explanation of its peculiar effectiveness as applied to gasoline vehicles designed for commercial work.

Gemmer Manufacturing Company—At booth No. 245 this company is exhibiting six models of steering gears, in addition to forgings and important parts. Models "C" and "K" are for pleasure cars up to 4000 pounds in weight. Model "O" is a design suitable for cars up to 2,500 pounds in weight.

Harrison Radiator Co.—"A radical departure in radiator design" is the way the makers of this radiator characterize their product. It is exhibited at booth No. 607.

Link Belt Company—The feature of this company's exhibit, which is installed in space No. 235, is the "Maximum" Silent

Fig. 29—G & J tires, Gray & Davis lamps, Splitdorf magnetos and Diamond tires, with Vacuum Oil exhibit in the background

Chain for power transmission. A Lambert car is shown equipped with these chains.

Livingston Radiator & Mfg. Co.—This concern, at space No. 250, is showing the Livingston Radiator complete and in sections.

Merchant & Evans Co.—At stand 501 is shown and described the Hele-Shaw clutch, combining the principles of the multiple-disc clutch and the cone by V-grooves. The Evans transmission jackshaft for trucks, the Star tire and tool case and the M. & E. grease cups are also shown.

Muncie Gear Works—This concern is exhibiting at space No. 244 a line of parts, including jack shafts, wheel brakes, brake drums and sprockets; a sliding gear transmission especially for motor trucks, together with front steering and solid

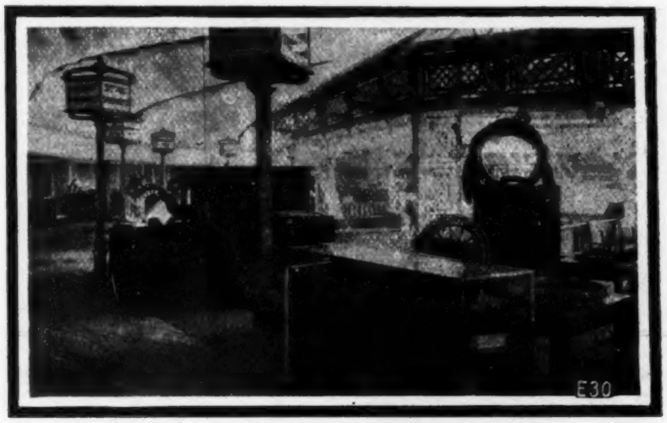


Fig. 30—Empire tires and Stewart speedometers centers of attraction in the balcony

Fig. 31—Klaxon horns accompanied by a new jack, Michelin tires, Bosch magnetos, Monogram oil and Ajax tires in a row

rear axles; also differential and planetary transmission gears, of which there are five models especially adapted for truck work.

New Departure Mfg. Co.—The complete line of bearings manufactured by this company is being shown at space No. 234. These include among others, the double-row or combined radial and thrust bearings, with cast bronze non-frictional separator.

Royal Equipment Co.—Duplex external brakes and Raybestos brake lining is the combination being played up at stand No. 252.

Spicer Mfg. Co.—The exhibit of this company, which is installed in space No. 169, consists of its standard line of universal joints, including the joints themselves and the rough and finished parts that go to make up a complete joint.

Standard Roller Bearing Co.—In the exhibit of this company at Booth No. 163 are shown examples of the output of this company, including standard annular ball, taper roller grooved ball thrust, journal roller and annular roller.

The Hayes Manufacturing Company is exhibiting in space No. 302 its line of sheet metal parts, including metal bodies, fenders, hoods, engine pans, gasoline tanks, running board shields, etc. Special features include a new channelled steel fender stiffener and the Hayes-Stanwood running board.

Timken-Detroit Axle Co.—This concern is showing at booth No. 167 drop-forged I-beam axles fitted with Timken roller bearings, also a commercial chassis and rear housing similarly fitted.

Timken Roller Bearing Company is showing at booth No. 166 a full line of its various series of bearings, including long

Fig. 32—Sonneborn oil is shown in the basement under interesting auspices

Fig. 33—Hartford tires, Goodyear tires and Solar lamps with a good site on the elevated platform

series bearings, used principally for commercial car service; the short series, used for pleasure car service, and the annular replacement series.

Warner Gear Co.—At stand No. 175 this concern is expatiating upon the merits of its 1911 product, featuring its model 95, 25-30 horsepower unit transmission, brake and control pedals, with Raybestos-faced disc clutch, and its Model 85, 35-50 horsepower unit transmission and clutch with Raybestos-faced or cork-insert discs.

Whitney Mfg. Co.—Whitney chains—the kind that are "built for strains"—are being exhibited at stand No. 123. Besides chains specially adapted for automobile work, this company builds chains for all kinds of power transmission.

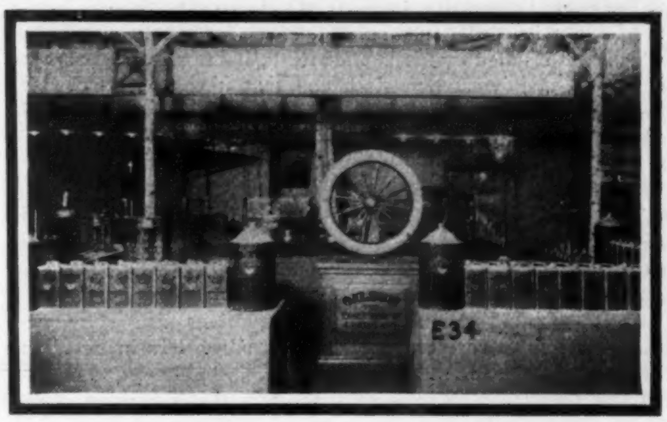


Fig. 34—Oilzum lubricants alongside of Col. Sprague's exhibit of windshields in the concert hall

Sound Signals

Atwater Kent Mfg. Works.—At space No. 281 is being shown a complete exhibit of this company's Monoplex electric horns and a comprehensive display of its ignition equipment, including the famous Unisparker.

Gabriel Horn Mfg. Co.—Sound signals of all sizes and power form the exhibit of this concern at space No. 180. Besides the three-tone, single-tube horn, the trumpet horn and the Foster Shock Absorber, there are being shown a new three-note Gabriel horn, and an automatic windshield cleaner.

Lovell-McConnell Mfg. Co.—The well-known Klaxon horn held forth at the exhibit of this company, which makes this well-known signal device at its Newark, N. J. factory. This company is preparing to market the Raiswell jack, said to be as different from the others of its kind as the Klaxon is unique in its class. (Booth No. 226.)

Nonpareil Horn Manufacturing Company—Thirty-four models of horns and a line of bulbs, reeds and tubing constitute the exhibit of this company in space 59.

Randall-Faichney Co.—The celebrated Jericho horns, Foy tail lamps and B-Line all-metal, oil-grease guns feature the interesting exhibit of this company at space No. 149 on the elevator platform.

Sireno Company—At the exhibit of this concern, at space No. 317, was shown the three general types which will be marketed in 1911. They include the automobile marine and motorcycle Sirenos. The automobile type is made in five styles and sizes, and the marine type in three.

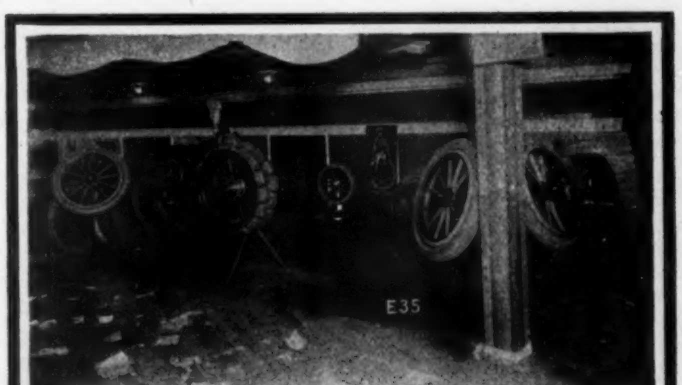


Fig. 35—Randall-Faichney exhibit adjacent to the Kelly-Springfield tire exhibit

Troy Auto Specialty Co.—At stand No. 315 this company is showing its pedal-operated "courteous" warning signal, for which it is claimed that it is effective at high or low speed; that it is rich, mellow and musical, and that it can be attached to the exhaust pipe in five minutes without mutilating the pipe in any way.

Tires and Tire Needfuls

The American Rim Company—In space 531 this concern is showing the Lambert Demountable rim. The feature of the device is the fact that the rim removes itself by the action of a brace tool unscrewing the rim bolt.

N. B. Arnold—Liquid tire preservatives are shown in space 547 by this company, which has headquarters in Brooklyn. The trade name for the feature display is "Slikup."

Atlas Chain Company.—At space 567, this company is exhibiting a non-skid chain of its own manufacture, a feature of which is a side chain fastening device which does away with the need of adjusters. The center links are drop forged from high carbon steel, heat treated for durability.

Auburn Auto Pump Co.—The Ten Eyck automatic self-starting, self-contacting and self-stopping tire pump makes up the exhibit at space No. 268.

The Automobile Tire Company, handling the Independent and Imperial brands of tires, occupies space 423. This company has introduced the idea of selling the same kinds of tires both guaranteed and without any warranty.

Ajax-Grieb Rubber Co.—With its 5000-mile guarantee, the Ajax tire is a popular proposition at the Garden. It is being demonstrated at stand No. 222.

Baker Sales Co.—This concern, representing the Double-Fabric Tire Company, of Auburn, Ind., is showing that tire along with a number of inside and outside blow-out patches for quick repairs.

Batavia Rubber Company—This exhibit of "Security" tread tires is conducted in space 278 by Harry L. Graff, of New York. It is claimed by the makers that the corrugated tread corrects skidding tendencies even in slippery going.

The Century Rubber Trading Company, occupying space 322, is showing the Century tire. Custom made tire equipment is the feature of this concern's product.

Consolidated Rubber Co.—Among the important exhibits of the Consolidated Rubber Company in space 148, is the line of Kelly-Springfield tires for commercial vehicles. One portion of this line which is attracting attention is a display of sectionally constructed tires.

The Continental Rubber Works is featuring its products in the display in space 144. The inner tube that is emphasized in this exhibit is heavier than the other tubes made by the company. In addition, a line of shoes, treads, patches, repair sleeves, bumper rubber, etc., is included.

Fig. 36—Atwater-Kent and Witherbee ignition exhibit, also Batavia tires

Frank H. Cross Co., Inc.—Pneumatic pumps are the feature of the exhibit in space 603. The line is manufactured by the Standard Sheet Metal Company, of Passaic, N. J.

Diamond Rubber Company—A full line of Diamond tires for pleasure cars is shown at space 128.

E. Edelmann & Co.—Tire gauges, oil gauges and a compressometer are shown by this Chicago concern in space 616.

The J. Elwood Lee Company, showing the "Jelco" tires and tubes has space 258. The feature of construction of this tire is the fact that it is reinforced by the imbedding of alternate laye s of steel discs so that they overlap without touching.

Empire Tire Co.—The full line of tires of this Trenton (N. J.), concern is shown at its exhibit at stand No. 231.

The Fegley Tire Chain Company is showing at space 526 a line of anti-skid chains. The bearing links are flat and thus do less injury to the tires than if made otherwise.

Firestone Tire & Rubber Co.—At space No. 164 the orators of the Firestone establishment are descanting on the merits of the complete line of quick detachable tires and demountable rims, including smooth treads for regular service and non-skids to insure safety on slippery streets.

Fisk Rubber Company—The virtues of Fisk tires and Fisk removable rims are demonstrated continually at stand No. 178 by the experts connected with the exhibit.

G. & J. Tire Company—A complete exposition of the 1911 line of G. & J. tires is set forth at the booth of the company, No. 131.

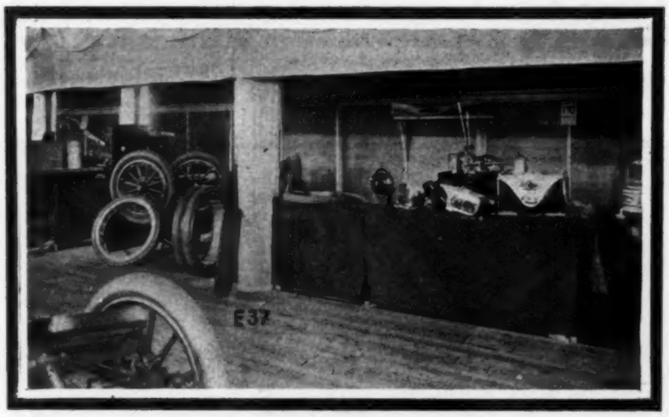


Fig. 37—Williams drop forgings, Warner autometer, Brown-Lipe equipment and Swinehart tires

James L. Gibney & Bro.—The feature of the exhibit of this firm, at space No. 557, is the Elec-trick Vulcanizer—a tire conserving outfit which will add thousands of miles to the life of a tire. It works on either direct or alternating current.

B. F. Goodrich Company—At space No. 127 this company is exhibiting its complete line of Goodrich White Tough Treads in both regular clincher quick detachable and straight bead construction. The Goodrich Metal Stud Tire is also shown, as is the Palmer Web Tire for electrics.

Goodyear Tire & Rubber Co.—A convincing exhibit of the excellencies of the Goodyear No-Rim-Cut Tires is being made at space No. 122, where the display of the above-named company is installed.

Hartford Rubber Works Co.—There are no weak spots in the exhibit of this concern, at stand No. 125. The full 1911 line, including the Hartford Dunlop, Clinchers, Quick Detach-

able and the Hartford Midgley Tread Non-Skid Tire, is shown.

Hazen-Brown Company—A line of tire repair accessories and what are termed "motor car necessities," is shown by this company in space 411. A cold vulcanizing outfit is the feature.

Hopewell Bros.—At stand No. 517 are being exhibited a full line of select Hopewell specialties, including the Hopewell waterproof tire cover, the Kinder tire cover; Hopewell lamp covers; Paos, a soap which just eats up the dirt.

Kellogg Manufacturing Company—Along with its regular line of compound and single-acting hand pumps, pressure registers, and tire testers, this concern shows at space No. 294 a full line of power air pumps; comprising the Quick Detachable Pump, the Electric Motor Driven Garage Pump, and a Four-cylinder Pump, which is designed for regular equipment.

Leather Tire Goods Company, at Booth No. 275, is exhibiting the 1911 Woodworth Tread, a new type of tire chain called Kant-Skids, and several types of repair boots and tire sleeves.

Fig. 38—Royal equipment, Star rubber, Livingston radiators, Miller tires

Michelin Tire Co.—In addition to the regular line of tires for ordinary use this concern is exhibiting at its booth, No. 225, the Michelin "Semelle" Anti-Skids, which, although having a tough, non-puncturing, leather tread, are yet flexible and resilient.

The Miller Rubber Company—Heavy truck tires are the leading item of the exhibit of this company in space 249. Known to the trade as the Palmer Truck Tires, the line is manufactured by the Miller company at Akron, O.

Morgan & Wright—Combining the wearing qualities of the plain treads with the protection against skidding and drive slipping of the best tire chains, the M. & W. tires promise to be a big factor in the 1911 field. They are being exhibited at stand No. 132.

Motor Tire Repair and Supply Company—The C. M. B. wrench and a steam vulcanizer are the main exhibits in space 582. The vulcanizer is a compact portable device for repairing tires both inside and out.

Motz Clincher Tire & Rubber Co.—At booth No. 248 this concern is showing its 1911 cushion tire, designed especially for gasoline and electric cars.

Myhtib Rubber Tire Preserver Company, Inc.—This company is showing a substance for preserving the fabric of tires in space 160.

Newmastic Tire Company—A tire filling to take the place of air is the feature of the display in space 502. For this substance it is claimed by the makers that it answers all the purposes of air in pneumatic tires. It is pumped into the inner tubes in liquid form and "sets" after a few hours.

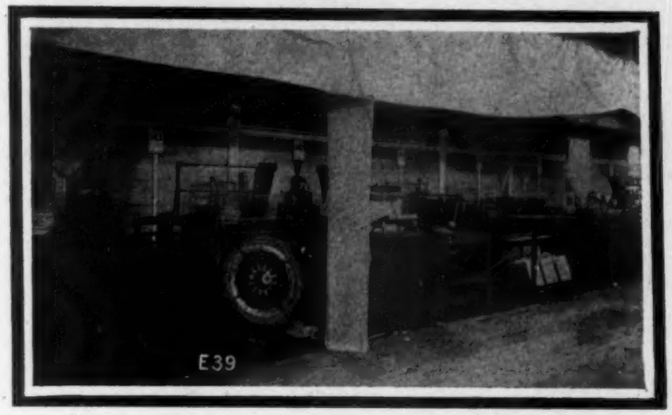


Fig. 39—Weed chains, Automatic Windshields, Non-Fluid Oil, Soot-Proof plugs, Jones speedometers and Diamond chains

Pennsylvania Rubber Co.—Pennsylvania Clincher Tires are vacuum cup tread tires which are specially designed to give traction on wet and slippery pavements.

Prince Tire Company—The exhibit of this company in space 626 is composed of specimens of Prince tires. The feature of this make is an inner pad or cushion of rubber, built as part of the tire.

W. K. Prudden & Co.—The Baker universal demountable rims are the leaders in the display of the Prudden Company in space 519. The chief feature of this device is its system of locking.

Republic Rubber Company.—Republic Staggard Tread Tires and inner tubes feature the exhibit of this company at booth No. 151. The latter are made in all sizes for foreign or domestic tires. Republic Truck Tires are also shown.

The Rutherford Rubber Company—Tires of an advanced pattern are shown by this concern in space 408.

C. A. Shaler Company—Taking current direct from city wires, the Shaler line of vulcanizers are a most useful adjunct to the car owner's outfit. They are demonstrated at stand No. 270.

The Shawmut Tire Company is showing tires, tubes and accessories in space 611. The exhibit consists of various types of wrapped tread clinchers and quick detachable tires; block treads, inner tubes and other varieties of tires.

Star Rubber Co.—This concern is showing its Star Non-Skid tire at stand No. 251.

Stein Double-Cushion Tire Co.—The peculiar construction of the tractor tread in the Stein Laplock Tire, which is being exhibited at stand No. 256, enables it to grip the road with tenacity, regardless of the conditions. The laplock base forms a solid wall between rim and inner tube.

Swinehart Tire & Rubber Co. is exhibiting at space No. 71 its complete line of solid and pneumatic tires for every type of motor vehicle, including the Rempes Web non-skid tire. On the pneumatic tires the company's regular smooth-tread in Q. D. and clincher styles is being shown.

Thermoid Rubber Co.—All the various rubber goods manufactured by this company are on exhibition at Space No. 232, including Thermoid brake linings, tires, inner tubes, tire reenforcements, hose, packing and tubing.

United States Wheel Company—Tires and wheels comprise the exhibit of this company in space 305. The tires are airless and are guaranteed by their makers.

Universal Tire Protector Co.—At space No. 414 this firm is showing the Universal Tire Protector, which has a means

of anchorage and adjustment to take care of the stretch inseparable from the use of leather stock, and prevent creeping and cuffing of the tread.

Voorhees Rubber Manufacturing Company—"Ideal" inner sleeves and twin sleeves are shown in space 421. The twin sleeve is designed to provide against blow-outs or rim cuts and fits over the tire shoe.

Weed Chain Tire Grip Co.—Brass-plated cross chains are the newest feature of the reliable Weed chains, which are invaluable when the roads and streets are covered with mud or snow. They are being shown at space No. 143.

Tops, Windshields, Etc.

Auto Windshield Company—The feature of this display is a shield divided vertically instead of horizontally, so as to avoid any metal crossbar in front of the driver's eyes. The exhibit occupies space 538. The driver looks over this shield. The shield is bent backward so as to deflect the air currents upward.

Broga Automatic Fastener Co.—This concern, which is showing the Broga Automatic Curtain Fastener, is housed in space 416. This device is patented in principle both here and abroad. The hub of the invention is a spiral coiled spring encased within concaved plates forming a socket button.

Fig. 40—Bowser gasoline equipment, Herz magnetos, Deitz lamps, Cramp castings

L. C. Chase & Co.—High-grade top materials for the automobile trade forms the exhibit of this company at stand No. 265.

The Cox Brass Manufacturing Company is displaying a line of accessories in space 625. This line includes windshields without any metallic crossbar, angle and straight bumpers, radiator-protectors, garage pumps of several types, oil guns and a variety of rails, brackets, tireholders, etc.

Detroit Motor Car Supply Company—Automobile tops in variety are the subject matter of the display of this concern in space 542. The display includes extension four-bow, three-bow runabout, small runabout, tops.

Ideal Wind Shield Co.—At space No. 522 is being shown the Ideal windshield, a light, strong, non-glass construction, giving full protection from wind and rain and deflecting dust-laden air currents upward and above the car.

Metal Stamping Company of New York—Hardware for use in automobile tops and bodies is the feature of the line shown in space 417. Among the items of the exhibit are curtain fasteners, prop rests, bow separators, brass screws and nails beside a variety of miscellaneous supplies of that kind.

L. J. Mutty Company—At stand No. 613 this firm is exhibiting its line of real mohairs and other mackintoshed cloths of every description, leathers, rubber cloths and other material adaptable to automobile top fabrics.

Novelty Manufacturing Company—Ajax and Kingsley windshields are among the exhibits of this concern in space 533. The company also shows radiators and fenders and other accessories. The shields are adjustable to an unusual number of positions to meet varying weather conditions.

Pantasote Company—At space No. 192 this company is showing a complete line of Pantasote top materials, exclusively their product, with various handsome linings. Also a line of mackintosh top materials in mohairs, etc., manufactured by them under the name of "Drikar."

Polson Manufacturing Company—The exhibit of this company consists chiefly of windshields, but also includes a line of bumpers and other devices. The shields are of the sectional type, made of heavy plate glass and framed in brass.

William E. Pratt Manufacturing Company—Pratt auto jacks, Climax auto jacks, Little Giant screw jacks, automobile tire supports and other malleable iron accessories are shown by this company in space 537.

Sprague Umbrella Co.—Colonel Sprague and a corps of assistants are on hand with a string of new ideas in windshields and similar equipment. His headquarters are just inside Concert Hall, space No. 301.

Charles O. Tingley & Co.—Automobile sundries of various kinds are on display in space 602. The chief exhibits are related to tire repair and include a vulcanizing fluid, tire patches, Gum-Gum, a substance for filling holes in tires, valve bases, cement, waste and numerous other items.

Troy Carriage Sun-Shade Co.—This concern, located at stand No. 548, is showing eight models of windshields for 1911. They are of quarter-inch Belgian plate glass, locked in adjustment at a constant tension, with no rattle or lost motion.

The Eagle Company—Windshields of this company's make are exhibited in space 605, in connection with a line of sparkplugs, cable reels, cleaners, and bumpers. Emil Grossman is in charge of the display.

The Newark Rivet Works—This company shows windshields in several types in space 295 at the Garden. The friction shield, featured in the display, is so designed that the company declares the upper half of the shield cannot be smashed by banging against the lower half.

The Union Auto Specialties Company is showing its line in space 530. Its leader is the 'Union" windshield which is framed in brass gauge tubing. The glass is 3-8-inch French plate, embedded in rubber to prevent rattling.

The Vehicle Apron and Hood Company—Motor fabrics and comforts in that line are shown in space 523. The trade name of the line is "Gordon" and the exhibit consists of everything from tire covers to fur robes, bags, and rainproof aprons.

General Accessories

J. Alexander & Co.—A line of automobile mirrors is shown in the space of this company, 415a. This exhibit has attracted a large amount of attention.

Harry A. Allers & Co.—"Solarine," a metal polish of wide use is shown in space 595. It is used not only for automobile cleaning but also for many other similar purposes.

B. M. Asch & Co.—A line of general accessories is handled by this New York house in space 616. The line ranges all the way from oil guns to speedometers and includes Rex Sparkplugs, Martin Strap Adjusters, engine cleaners, motor rope, tools of various kinds, pumps, horns, trunks, chains, etc.

Auto Specialties Company—The Ciglia Glare Dimmer, a device to lessen the intensity of the headlight when necessary is

the feature of the exhibit in space 525. The company also shows the "Bougie Eyquem" an imported spark plug.

Gus Balzer Company, Inc.—Besides its line of carbureters this company is showing the Stevens Igniter, mirrors, ornaments, license lamps, and an improved type of tire air tank.

A. U. Campbell—A locking device to prevent joy riding and theft of the automobile is shown by this concern in space 409. This device consists of a lock in the top of the control lever which effectively checks theft while leaving the brakes clear so that the car can be moved in case of accident.

Clayton Air Compressor Works—An air compressor for garages is shown by this company in space 610. It consists of a 3-horsepower electric motor and a vertical high speed compressor 4 3-4 by 4 3-4 with automatic starting and stopping devices.

Dahlstrom Metallic Door Company—Metal doors for automobile lockers and for other purposes are shown in space 536a.

C. F. Ernst's Sons—This display consists of an "Ernst" automobile turntable and wash rack. It consists of a heavy iron drum with a hardened steel resistance pin in the center and revolving on large hardened steel balls bearing in grooves cut in ball runs. The bearings are protected by water and sand. The exhibit is housed in space 514.

International Metal Polish Company—Blue Ribbon Cream Metal Polish is on display in space 415. The substance is used to polish metal parts of automobiles and is highly recommended.

Phineas Jones & Co.—Wheels for pleasure cars and trucks constitute the main features of this exhibit, which is in space 136. The company is located at Newark, N. J. It specializes also in repairing and truing old wheels and experimental wheel work.

F. H. Kelsey & Co.—How to prevent joy riding has been a problem ever since the automobile came into general use. This company declares that it has solved the problem in the Saunders Auto Lever Lock, which it is showing in space 409a.

Kilgore Manufacturing Company—Elastic air cushion shock-absorbers is the chief display in this company's space, number 509. The air compression principle is used in this device, which works in both directions with equal facility.

Julius King Optical Company—Automobile goggles in great variety are shown in the display of this concern in space 556. The goggles range in price and style between 75 cents and over $5 a pair. Beside the goggles the company shows watches, clocks, instruments, compasses, glasses and measuring devices.

C. A. Mezger, Inc.—Windshields, spark plugs and parts are shown by this company in space 142. The feature of the display is the windshield section.

New York Sporting Goods Company—Friction lighters, exhaust signals and a general line of accessories are shown by this company in space 500. The matchless lighter is designed to afford a means of lighting lamps when matches are not available.

North & Judd Manufacturing Company—Automobile hardware, including door and grab handles, robe and foot rails, washers, hinges, etc., is shown in the display of this concern in space 324.

Oliver Manufacturing Company—Jacks for use in making tire and other repairs to cars is the line shown by this company in space 165. Models of 1911 are shown in several styles and types useful for cars weighing from two to eight tons.

Post & Lester Company—An interesting line of accessories is displayed by this company in space 550 in the basement.

J. H. Sagar Company—Equalizing springs made in the Rochester factory of this company are shown in detail in space 267. The Sagar is a coiled spring which is attached to the axle and the frame with substantial bolts. The company also shows the Spark-O-Lite, for lighting lamps automatically.

S. B. R. Specialty Company—Muffler cut-outs, jacks and a line of miscellaneous accessories is shown by this company in space 614. The cut-out is the feature of the display and is shown in several grades ranging from the simplest form of this device to those of much more elaboration. Rapidcut, an abrasive for grinding in valves, and a cement are shown in addition to the mechanical exhibits.

Springfield Metal Body Company—This company, showing in space 193, has on display a torpedo and a limousine body of characteristic workmanship.

John T. Stanley—Space 554 is occupied with a display of soaps, cleaners and cleansers of use in keeping the automobile clean. Concrete cleanser, for garage floors; Shofo, for hand-cleaning, Mobo, for car cleaning, are shown.

The Fay Machine Tool Company—A machine lathe in operation constitutes the exhibit of this Philadelphia company in space 536.

The Mutual Auto Accessories Company—A full line of the little and big things that come under the general head of accessories is shown by this New York company in space 583.

C. A. Willey Company.—Colors in bewildering variety are shown in the exhibit of this company, space 420. The line consists of paints, glosses and varnishes for automobile work.

The Wright Wrench and Forging Company—In space 401

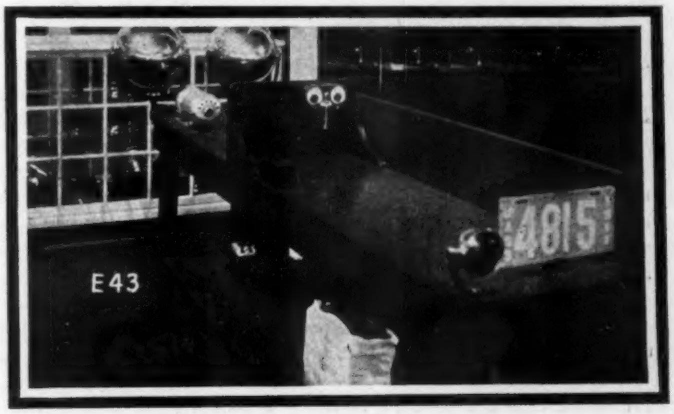


Fig. 41—Gray & Davis electric lighting system, with dynamo and equipment shown connected up

the line of wrenches, tools and devices of this company are shown. The leader is the Wright one-hand wrench.

U. S. McAdamite Metal Company—A line of name plates made of the metal produced by this company is shown in space 591.

Valentine & Co.—Vanadium body varnishes are the main exhibit of this concern in space 183. Its makers recommend it as waterproof, oilproof and mudproof and say that its surface remains smooth for long periods under hard usage. Other displays are Vanadium finishing varnish, gear, quick gear, guard, leveling, flatting varnishes in several qualities.

Allen Auto Specialty Co. is showing a line of its products in space 623. These are largely applicable to tires and in part consist of covers, holders, locks, pressure gauges, lamp covers, boots for knuckles, exhausts and universal joints. A simple pressure gauge to test the amount of air in tires is the feature of the line.

Ashland Mfg. Co.—Crown Auto Jacks provide the main feature of this company's exhibit, which occupies stand No. 406.

Brown Company—Compressometers, tire pressure testers, spark plug wrenches, valve-grinders, combination oil and grease guns and "auto-creepers" (for repair work under a car), all of its own manufacture, featured the exhibit of this company at booth No. 572.

The Chandler Company is located in space 157. The

company makes name plates and stampings of a variety of styles, including raised and depressed lettering on every sort of material. One particularly effective style is in baked enamel, but the line embraces the whole field.

Coes Wrench Co. is showing at space No. 155 its special narrow-jaw automobile wrenches for automobile work.

C. Cowles & Co.—Besides its regular line of limousine and electric coupé trimming, such as toilet cases, annunciators, electric side, tail and dome lamps, ventilators, umbrella holders, cigar lighters, anti-rattlers, curtain fasteners, foot warmers, etc., this concern is demonstrating at space No. 271 a swivel extension megaphone speaking tube horn, so constructed as to permit driver to place the horn to his ear at any desired angle.

Dover Stamping & Mfg. Co.—Handy garage equipment, such as radiator and gasoline tank fillers and strainers of various capacities, and quantity-marked, make up the exhibit of this concern, which holds forth at booth No. 313.

Chas. J. Downing—In the basement, space 604, showing full line of Star tires and tubes, jacks, Cataract washer, Oneita Electric Horn, brass and aluminum parts, lamps and generators, "Fitzall" blow-out patch, storage batteries and an improved sectional adjustable vulcanizer.

Elite Mfg. Co.—All kinds and sizes of automobile jacks form the exhibit of this concern at space No. 580. The Reliable tire saver, to keep tires off oily garage floors, and the storage stand, for use during the lay-up period, are features.

Ernest Flentje—At space No. 546 is exhibited the Flentje Hydraulic Shock Preventer, which is claimed to give perfect flexibility and steady travel under all load and road conditions.

The Walter H. Foster Company is showing an all-geared, multi-spindle drill in space 570. The drill is used upon tough, high-grade alloy steels. The substitution of gears for the universal joints, permits a design of sufficient strength to operate high speed drills of any make.

Gilbert Mfg. Co.—Motor car accessories of all sorts form the bulk of the exhibit of this concern at stand No. 272. The Gilbert spare tire cases and spare tire brackets are featured.

Hartford Suspension Co.—The time-honored Truffault-Hartford Shock Absorber is being demonstrated at this company's stand, No. 156.

H. W. Johns-Manville Co.—Asbestos in its various applications to automobile work forms the exhibit of this concern at space No. 255.

Charles E. Miller—One of the largest automobile supply houses in the country, the exhibit of this concern, at space No. 161, was naturally most comprehensive.

Motor Car Equipment Co.—This concern, which is the distributor for the Glasso Company, makers of Glasso, a preventer of foggy windshields, demonstrated the quality of its product at booth No. 562.

Noera Mfg. Co.—At this company's stand, No. 273, is being featured its compound automobile pumps, noted for their simplicity, strength, compactness and durability.

Randerson Auto Parts Company—Protection of the radiator is an important part of the operation of the automobile as that device is most frequently injured in accidents of all kinds. The company, space 450, exhibits an adjustable bumper.

Randolph & Co.—Imported automobile clothing for men is shown at the booth of this concern, space 424. The line consists of rubberized cloth raincoats, caps of various styles, mufflers, waistcoats and quite a large variety of other items.

P. Rielly & Son, manufacturers of all kinds of patent and enameled leather for upholstery and body trimming, are exhibiting in space 566. This line includes a variety of leathers finished in colored enamel, dull, bright, morocco, patent calf and patent shoe leather. The company's factory is located at Newark, N. J.

The Morrison-Ricker Manufacturing Company, in space 158, is showing its line of Grinnell gloves. These consist of "Rist-fit" ventilated and unventilated, de Luxe, short gloves, gauntlet finger mittens and finger mittens with elastic wrist web, besides a number of other styles for the use of motorists.

The Turner Brass Works—The Harroun bumper for the protection of the front end of the car and a host of metal accessories for various purposes constitute the display of this company in space 240. Coat, robe and foot rails, tire carriers and the Turner Pressure Floor Pump are among the things shown.

The Valve Seating Tool Company holds forth at space 620. This company shows several portable polishing and grinding machine tools intended for hand use is valve repair work. Electric power is used in operating the tools and each is fitted with controlling chuck, cord and plug to fit any lamp socket.

Westen Mfg. Co.—At space No. 609 this company is exhibiting the Westen two-degree friction plane shock absorber, the only one of its kind on the market.

J. H. Williams & Co.—This concern is showing, at space 173, its "Ratchetless" Ratchlet Rench, Vulcan Auto Tool, Diamond "W" popular wrench sets, and a new spark plug wrench.

Ajax Trunk and Sample Case Company—A full line of automobile trunks, carriers and racks is exhibited by this concern in space 549. One of the trunks shown is known as the Ajax Motor Restaurant Tire Trunk which fits inside one of the spare shoes. When removed it serves as a table with folding legs and contains receptacles for carrying food for six persons.

Gardner Engine Starter Company- In space 551 this company shows a line of accessories among which is an auxiliary engine base used to facilitate repair work.

Hagstrom Brothers Manufacturing Company—Tire patches and spark plugs are displayed by this company in space 404. The patch is applied inside the shoe and is held in place by a metal hook. The feature of the spark plug is its non-conductive porcelain guard.

Keen Starter Co., Inc.—The attendants at stand No. 529 are setting forth the merits of the Keen Starter, a simple device working on the Archimedes screw principle. They show that by the simple pulling of a lever from the seat the car can be started.

Protectroid—This concern shows a varnish protector in space 305a. For its product the company claims that it will double the life of the varnished surfaces of the automobile.

Star Starter Company—A simple, effective and inexpensive system of starting an automobile motor without cranking has long been sought by engineers throughout motordom. The exhibitors in space 543 at the Garden claim that they have such a device in the Star Starter.

Joseph Tracy—In space 545, Mr. Tracy is conducting a testing laboratory. Test blocks and universally adjustable motor supports are shown in operation.

Wycoff Lumber & Manufacturing Company—Portable garages made by this company, which has headquarters at Ithaca, N. Y., are shown in space 515. The garages are shipped in "knocked down" shape from the factory and may be erected anywhere that enough level ground can be found for them. Rigidity of construction is a feature emphasized by the company.

Drop Forge Men Say "Howdy"

Some sixty odd representatives of the various drop forging plants all over the country met Tuesday at the Murray Hill Hotel and said "howdy do" to one another. A committee announced afterward that no combination or association had been formed. The committee declared that the only matter of business that came before the meeting was a discussion of standardization.

Selden Patent Not Infringed

COURT HOLDS AGAINST A. L. A. M. AND IN FAVOR OF FORD AND OTHERS IN LITIGATION BROUGHT TO ENFORCE PATENT

COMING at a dramatic moment, while the great automobile show conducted under the auspices of the A. L. A. M. was unfolding in all its glory at the Garden, the United States Circuit Court of Appeals announced its decision of the famous Selden Patent case Monday evening, adversely to the interests of the A. L. A. M.

Judge Noyes wrote the opinion of the court and held that while the Selden patent covering an early type of automobiles was valid it did not cover the basic features of the Ford car and others joined with the Ford company as parties defendant to the action. The court orders the cause sent back to the trial court to be dismissed with costs upon the complainants.

The decision came like a clap of thunder and was entirely unexpected by the exhibitors at the big show. The whole atmosphere seemed to take on an electric quality after the announcement and it was not until the next morning that some of the members were acquainted with the facts.

Dugald Clerk's Deposition

This Testimony Had a Marked Bearing Upon the Case

HAVING been duly sworn, Dugald Clerk, of London, England, probably the most famous expert in patent matters in Great Britain, holding memberships in the Institute of Civil Engineers; Fellow of the Chemical Society; Fellow of the Society of Chemical Industry; Member of the Royal Institute; Fellow of the Chartered Institute of Patent Agents; Member of the Gas Engine Research Committee of the Institute of Mechanical Engineers; Member of the Committee of the Efficiency of Internal Combustion Engines—Institute of Civil Engineers; Member of Executive of The British Science Guild; Member of Patent Law Reform Committee of that body; James Watt Medalist, Institute of Civil Engineers, 1882, Telford Prizeman, Institute of Civil Engineers, 1882-1886; President's Medalist, the Gas Engine Institute, 1902; Member of the Automobile Club of Great Britain and Ireland; Member of Expert and Technical Committee of that body; a Judge of the Automobile Club Trials at Richmond Shows, 1889; Also 1,000 Miles Trial, 1900; also Glasgow Reliability Trials, Glasgow Exhibition, 1901; Crystal Palace 1,000-mile Reliability Trial, 1903; new President of the Junior Engineers; author of scientific papers, books and lectures. The Theory of the Gas Engine, Institute of Civil Engineers, 1882; On the Explosion of Homogeneous Gases, Mixtures, Institute of Civil Engineers, 1885; The Specific Heat of Gases at High Temperatures, Society of Chemical Industry, 1886; and among a considerable number of books on Gas Engines, etc.

The testimony in relation to Dugald Clerk's competence included a long series of incidents going to show that his familiarity with internal combustion motor problems is most marked.

In order to show something of the state of the art, the Clerk testimony brought out dates as follows:

1876—"While I was engaged with Professor Mills I found an Otto and Langen at work in a joiner's shop in Glasgow. This engine was of the old atmospheric type * * *."

1877—"I designed an engine, made all the working drawings myself. This engine is shown in my English patent No. 252."

1876—"This engine was built from my designs in my father's works * * *."

1877—"During nearly the whole of this year I was engaged in inventing, building and testing modifications of this engine."

1877—"Toward the end of (this year) Mr. Sterne, who had connections in New York, had visited New York, and sent over to Messrs. Sterne company's works in Glasgow an engine built by the New York & New Jersey Motor Company, a Brayton engine in fact."

The Brayton engine as referred to in Dugald Clerk's testimony was illustrated on page 153 of the defendants' exhibit No. 111.

1878—"I was the only one in that works who understood these matters, and early in 1878 I made a test from that engine, that is, on February 21 and 22, 1878."

"This Brayton engine provided my first experience of an engine operated on the compression principle * * *"

"I made experiments upon the heat value of the petroleum used, and was somewhat disappointed with the practical efficiency obtained * * *"

"I saw at that time, after making this test, that the Brayton engine could be altered with but little trouble to operate as an explosion engine, exploding under compression * * * I then proceeded to alter the Brayton engine."

"The first alteration consisted in rearranging the inlet valve and providing a spark plug to ignite the mixture electrically."

"The electrical ignition was made by a built-up spark plug, similar to the Lenoir engine, with the construction of which I had become at this time familiar, although I had never seen a Lenior engine at that date."

"This experiment proved that the Brayton engine, working as an explosion engine, gave more power than working in the ordinary flame method."

"I accordingly invented another type of igniter which I thought would prove simpler in practical operation. This igniter was subsequently known as the platinum grating igniter and is illustrated, so far as the platinum cage is concerned, at page 223 of defendants' exhibit No. 111."

"After running the Brayton engine for some time in this way, I came to the conclusion that although good results were obtained scientifically the construction was not one which was really suited for the English market."

"I accordingly invented and designed a form of gas engine fully described in my English patent No. 3,045 of 1878."

1879—"This engine was built and running by the year 1878, but an accident occurred (my first rather serious explosion) by which the engine was broken into two parts. I at once had to redesign the parts and reconstruct the engine. The reconstructed engine worked very satisfactorily and it was exhibited at the Royal Agricultural Societies Show at Kilburn, London, in the middle of 1879, I think it was the month of July * * *"

"This engine was seen by many hundreds of people."

"This larger engine, or rather the improvements embodied in the larger engine as described in my English patent No. 2,424 of 1879. This engine was of nine brake horsepower, and it was running by the end of 1879. The Great Otto patent, or what was known as the Otto silent engine, was dated August, 1876, but I saw nothing of it until early in 1878, when my attention was

distracted from the real point of the patent by the long account of stratification which Otto supposed to be his real invention."

"I saw my first Otto silent engine in operation shortly after the test of the Brayton engine early in 1878, and then I saw a number of these in operation at the Bristol Agricultural Show in 1878. I am not sure whether this was the Royal Agricultural Show. I rather think not. At this 1878 show I exhibited a Brayton engine built at the Sterne's works, operated in the well-known Brayton manner, with slight mechanical improvements."

1878—"I became acquainted with a gas-making apparatus, making gas from gasoline. This apparatus was applied to several Otto engines, and I saw Otto engines, or rather an Otto engine, operating with this gas at the Bristol show in 1878, and also at the Kilburn show of 1879."

1883—"My interest in compression being thoroughly aroused by the Brayton engine, I made a careful search of the Philosophical Library in Glasgow early in 1878, and also Sterling's Library in Glasgow, when I got together practically all the data forming the historical sketch of the gas engine beginning defendants' exhibit No. 111. I remember, however, that there was one matter included in that historical sketch which I did not know in 1878 and 1879. That matter was the description of the Beau de Rochas pamphlet which I did not know of until 1883."

"In 1879 and onward a certain theory of the action of these engines was stated, which is generally known as the stratification theory. It was supposed that economy of the modern engine then on the market was not due to compression, but due to other things, all included in the word 'stratification.' This provoked me to investigate the whole matter carefully, and go into the state of knowledge on the subject as to gaseous explosions, and all of this was embodied in a paper read by me to the Institute of Civil Engineers in London in April, 1882."

"This paper attracted a good deal of attention, because it laid down, I believe for the first time, the true theory, so far as thermo-dynamics are concerned, of mechanical compression in gas engines."

"The work done by me on the compression explosion engine up to the end of 1879 had thus resulted in the production of the first compression explosion engine ever run, giving an impulse at each revolution."

"Although this very cycle had been proposed by Million in 1861, it never seemed to have been actually operated until I built this engine in 1878."

"* * * I accordingly worked hard during the years following and then invented the engine described in my English patent No. 1,089, of 1881."

"The specifications describing the engine (was) subsequently known throughout the world as the Clerk cycle engine."

1882—"The paper (this year) was published in America in D. Van Ostrand's engineering magazine, and also as a United States Government document * * *" (Referring to experiments with pure hydrogen and air as described in defendants' exhibit No. 111).

1884—"An action was brought against Messrs. Sterne Company by Crossley Brothers for the infringement of the 1876 Otto patent on the ground of the stratification claim in that patent. Messrs. Sterne & Company, after fighting the matter to a certain length, invited me to take up the investigation, and unfortunately my funds were insufficient at the time and I was unable to do it. They then made a royalty arrangement with the Crossley people * * *"

1886—"I joined the well-known firm of Tangye's, Limited, of Birmingham, * * * While there I devoted myself to further study and experiment with the gas engine, and produced an engine shown in my English patent No. 12,912 of 1886. This engine had some little sale, but the lapsing of the Otto patent made it obsolete from a commercial point of view and the engine went no further."

1888—"I joined with my present partner Mr. G. Croydon Marks, also formerly of Tangye's engineers, * * *"

1889—"I built an engine described in English patent No. 8,805."

1891—"I produced an engine under British patent No. 12,413; this engine operated on the Otto cycle."

Other dates referred to in the Clerk testimony of his early operations were given, but they are not important from the present review point of view, so that reference will now be made to testimony as follows:

"Q. 3.—Have you carefully read the Selden United States patent No. 549,160, being the patent sued upon in these cases, and, if so, do you understand the construction and mode of operation of the road engine shown, described and claimed therein?

"A.—Yes, I have, and I do.

"Counsel for complainants state that it is desirable for Mr. Clerk to examine certain Brayton engines which are located at Hartford, Conn., and also to make further examination of the engines built by Mr. Selden and to give further consideration to the proofs in these cases before proceeding further with his deposition and, therefore, an adjournment is requested until Thursday, July 19, 1906."

"Q. 6—Please state what you understand to be the construction and mode of operation of the road engine shown and described in the Selden patent No. 549,160 and particularly set forth in claims 1, 2 and 5 thereof, and what you understand to be the invention set forth in this patent * * *

"A. * * * I find described a liquid hydrocarbon gas engine of the compression type, arranged to operate a road vehicle having a suitable liquid fuel receptacle, I find a power shaft arranged to run faster than a propelling wheel, an intermediate clutch or disconnecting device between the power shaft and the propelling wheel, a propelling wheel or wheels and steering mechanism, suitable running gear connecting between the engine and the propelling wheel and a suitable carriage body.

"* * *I find a three-cylinder engine of the compression type mounted upon a front driving axle, and a compressed air reservoir.

"The three-cylinder engine operates as to each cylinder in accordance with either of the thermo-dynamic cycles explained in my answer to Q. 4."

Q. 4 and the answer thereto referred to a glass model of the Selden application which was used during the trial.

"No specific arrangement is mentioned for starting the engine, but it would be obvious to any mechanic in May, 1879, that some means must be provided to rotate the crank in order to compress the air and put in operation the combustion cycle of the engine.

"I may say that before the date, May 8, 1879, I had considerable experience in starting internal combustion motors having air or air and gas reservoirs."

"I had experience in starting engines of the explosion type, and would refer particularly to the engine described in my British patent No. 3,045 of 1878, which was started by turning the crankshaft by means of a handle in a way exactly similar to that which I have recently practiced in starting the Selden three-cylinder engine."

"I may refer again to my British patent No. 3,045 of 1878, which operates on the explosion or constant volume cycle, which could be used on Selden's engine, Fig. 3, and in this patent will be found the particulars of water-jacketing of both motor cylinder, air pump and cover for both cylinders. At the same date Brayton's engine used cylinders which were well water-jacketed, and so far as water-jacketing is concerned the art of water-jacketing was thoroughly well known at the date of Selden's application."

"The inventor believes that he could alter any existing carriage to take his locomotive and steering mechanism."

"So far, I gather from my study of the specifications that great stress is laid by the inventor upon the use of liquid hydrocarbon engines of the compression type as being the main cause of success in his invention claimed in the three claims in suit. I gather also that, although he gives one drawing of an engine and particularly indicates that it is operated on the constant pressure or flame cycle, he in no way excludes the explosion cycle, but appears to include it as I shall shortly point out."

"I have now dealt with my own understanding of the operation of the mechanism with reference to various essential points in the specifications as bearing upon the meaning of the claims, and I will now come to the claims themselves. I will deal, therefore, with Selden's first claim. It is:

" 'The combination with a road locomotive, provided with suitable running gear, including a propelling wheel and steering mechanism, of a liquid hydro-carbon gas engine of the compression type, comprising one or more cylinders, a suitable liquid fuel receptacle, a power shaft connected with and arranged to run faster than the propelling wheel, an intermediate clutch or disconnecting device, and a suitable carriage body adapted to the conveyance of persons and goods, substantially as described.'

"As I have already said, it is obvious from the specification that the inventor attaches the greatest possible importance to this liquid hydro-carbon engine of the compression type as forming the chief element in the new combination.

"Speaking broadly, I find that the main invention claimed in the first claim requires the following elements:

"(a) A liquid hyro-carbon gas engine of the compression type (with one or more power cylinders).

"(b) A suitable liquid fuel receptacle.

"(c) A power shaft arranged to run faster than the propelling wheel.

"(d) An intermediate clutch or disconnecting device.

"(e) A propelling wheel or wheels and a steering mechanism.

"(f) A suitable carriage body.

"That is, his invention, so far as the first claim is concerned. comprises in combination the six elements, a, b, c, d, e, f."

Clerk went on to say: "From this description alone it would not be possible to say whether the inventor intended to operate the engine shown by flame or by explosion, although the existence of dotted lines to the left of the combustion chamber T^1 makes it probable that Selden's idea was to operate this particular engine on the flame type.

"At line 42-49, page 3, a significant statement occurs which settles in my mind the particular operative cycle intended to be used by the inventor according to the description of the drawing. Here it is stated: 'As it would be decidedly inconvenient to be under the necessity of extinguishing the flame in my improved traction engine whenever it was required to make a short stop, the clutch Y (or the clutches j, j^1) is interposed between the engine and the driving wheels so as to admit of the running of the engine while the carriage remained stationary.' This statement makes it clear to one like myself, conversant at the date of the application of the patent, May, 1879, with the various types of operative cycles proposed for internal-combustion motors, that in this particular example given the inventor intended to use the constant-flame cycle. In no other thermodynamic cycle known to me would the stoppage of the carriage and the engine involve the extinction of the igniting flame.

"Before May, 1879, I had operated compression internal-combustion motors with electric ignition, but at that time I was more familiar with the flame type of ignition and had more confidence in its constancy and reliability. In 1879 I would have preferred to have applied a flame lighting contrivance to produce an explosion as well as to use the flame for constant pressure. Such flame arrangements were well known and a suitable device was that used very largely upon the Otto Langen three-piston engine as well as upon the Otto silent engine, as the four-cycle engine was then entitled.

"Previous to the date, 1879, however, I myself had invented an incandescent grating igniter and used it upon an explosion engine, which is described and illustrated in my British specification 3,045 of 1878.

"I should perhaps say that at the date, May 8, 1879, I was familiar with the Brayton flame engine, which engine operated upon a constant-pressure cycle after the manner first described by the well-known Sir William Siemens as far back as 1860. This cycle was also described in F. Million's English patent No. 1,840 of 1861. In this patent Million describes an engine which may be operated indifferently as explosion or flame by varying the timing of the electric spark. Million appeared to be the first to explain the constant volume cycle * * *.

"The Otto cycle engine also existed and was well known on May 8, 1879, and even so early as that date it was known that it could be operated either on the explosion or the constant cycle."

"Q. 7—You have used in your answer Q. 6 the terms 'constant pressure or flame cycle,' 'constant volume or explosion cycle,' and 'compression type of engine.' Please explain these terms, and in doing so state the difference between them, if any?"

"A.—I think perhaps it will be better to go very shortly into a little of the history of the subject. About the year 1844 the late Dr. Joule, of Manchester, famous as the discover of the first law of thermo-dynamics, namely, the mechanical equivalent of heat, originated a power cycle which was known as the Joule cycle. In this cycle of operation two cylinders were supposed to be used, a pump cylinder and a motor cylinder. The function of the pump was to draw in a supply of air from the atmosphere and compress it in a reservoir. This reservoir was metallic, and it was heated by an external fire. The air compressed in this heated reservoir was supplied to the power cylinder of an engine. and the power was obtained by the increase of volume of gases compressed into the hot reservoir because of the heat added. It is obvious that as the volume of the air varies directly with its absolute temperature, or the pressure varies directly with its absolute temperature, as explained in answer to Q. 6, if one cubic foot of gas compressed in this hot reservoir be heated to double the absolute temperature when pumped into the reservoir, then instead of one cubic foot of motor fluid coming out of the reservoir (one cubic foot being put in by the pump) two cubic feet will come out of this reservoir.

"In this operative cycle the pump had only resistance enough to its work to force in one cubic foot, whereas the motor cylinder took up two cubic feet at the same pressure, excluding valve and clearance losses, and accordingly the engine could be run in this way without any increase in pressure above the pressure of compression. This type of engine became known among scientific engineers as a constant pressure engine because the power theoretically obtained was obtained without any increase of pressure above the pump pressure.

"This cycle has been used practically by the well-known Captain Ericsson, of the United States of America. He built a boat with engines of this type about 1864.

"(Answer to Q. 7 continued.) From what I have said it will appear that a constant pressure engine, broadly, is an engine in which power is obtained by heating air in such a manner that volume is increased but not pressure.

"In the application of this constant pressure cycle to internal-combustion motors, the heating of the air is accomplished by means of flame instead of by transmission through metallic walls.

"The constant volume cycle of operation for producing motive power from heated air is rather older than the constant pressure cycle. It was originally invented by a Scotch clergyman named Dr. Stirling about the year 1812. In it also air from the atmosphere was used as the working fluid. In this cycle of operation, which was long known as the Stirling cycle, a constant volume of air was contained in a chamber or cylinder, the lower end of which cylinder was kept hot by a furnace. The upper end was cooled by water circulation. A loose plunger was fitted within this vertical cylinder or chamber, the lower end was made of heat-resisting material, and it was insulated as far as possible from the upper end. This plunger was reciprocated to and fro within the cylinder referred to with the following result: When the plunger was at the bottom of the stroke so that little space existed between the plunger bottom and the hot bottom of the chamber, it is obvious that the bulk of the air contents of the cylinder would be exposed to the cool end of the cylinder. Under such circumstances the bulk of the air in the chamber would be cold. If now, the vessel of course being closed, the plunger be raised to its upper position, then the cold air would be transferred around its sides down toward the hot bottom of the vessel. As no change of volume would occur, that is the volume of the vessel was a constant, and the greater part of the air was now transferred to the hot end, the pressure within the vessel rose. This raise depending upon the amount of heating of the air and being proportional, as I have explained already, to the mean absolute temperature of the body of air enclosed. This operation increased the pressure of the air within the vessel and this increase of pressure was utilized in an outside cylinder. The downward movement of the plunger then occurred and the pressure again fell, because of the cooling of the mass of air; the outside cylinder piston was then returned, either operated by a flywheel or by another similar hot vessel. The moving plunger in the hot-air vessel was known as a displacer because its function was simply to displace air from the cold end to the hot and from the hot to the cold alternately. Engines of this kind were built by Dr. Stirling and were operated at the Dundee foundry as early as 1837. This engine was known as a constant-volume engine. The application of this principle to internal-combustion engines was very simple. In its earliest application all that was done was to draw in a cylinder a mixture of inflammable gas or vapor and air at atmospheric pressure to ignite that mixture and so heat the air. The assumption was that during the process of ignition the volume did not change and the pressure did."

There are 2,180 pages of Dugald Clerk's testimony entitled "Direct Testimony and Testimony on Cross Examination of Dugald Clerk as Witness for the Complainants in Rebuttal," United States Circuit Court, Southern District of New York, dating from July 12, 1906, to the completion of the task in October, 1906. It would be impossible to present any considerable proportion of this testimony here, but the point has been to offer enough of it to establish the contending conditions surrounding the Brayton engine and its use by Selden.

The Ford Side of It—Selden Patent Status

Much doubt exists in the public mind as to the exact nature and status of the Selden patent, which when carefully analyzed is a very simple patent. To quote from the original patent claims issued in 1879 it was "The combination with a road locomotive, provided with suitable running gear, including a propelling wheel and steering mechanisms, of a liquid hydro-carbon gas engine of the compression type comprising one or more cylinders, a suitable liquid fuel receptacle, a power shaft connected with and arranged to run faster than the propelling wheel, an intermediate clutch or disconnecting device and a suitable carriage body adapted to the conveyance of persons or goods substantially as described."

In the original trial courts the court decided that Selden was a pioneer in these patent claims and that other makers using motor cars to-day infringed the patent. In a word, the patent is a combination one in which several parts are combined to form a motor car as used to-day. These combined parts are an engine of the compression type using gasoline or other petroleum as a fuel, a running gear consisting of frames, axles and springs, propelling wheels, connection between motor and propelling wheels so that this drive shaft, or propeller shaft as it is known to-day, in shaft-driven cars would revolve faster than the rear wheels, and lastly and of greatest importance the clutch of any type, whether cone, multiple disc, expanding or contracting band which would allow the motor to run with the car idle. The value of this important feature will be at once appreciated because there is not a gasoline car made to-day which would be operative were it not for this. According to the trial court, Selden adopted what is known as the Brayton two-cycle motor of the compression type, approximately 35 pounds compression, which was invented by one Brayton in 1872 and 1874. Selden took this motor and "devised and used an arrangement of it which Brayton had never attempted and which Brayton himself never suggested, made or patented."

By this arrangement which Selden made it was possible to get more than 40 per cent. power out of the Brayton engine and so make it possible for use on a running gear. The original Brayton engine was a very heavy two-cycle stationary design with an open crankcase. Selden enclosed the crankcase and greatly reduced the weight. He also changed the manner of furnishing the fuel to the cylinders which greatly enhanced its power and made it what might be called a high-speed engine. From this brief statement of the case it is quite clear that the Selden patent was not the invention of some entirely new feature. Engines had been used on road vehicles previous to 1830 and were of the steam type. Clutches were old designs. The method of transmitting power from a motor to road wheels was old. In fact every unit in Selden's combination patent was old. The trial court held that Selden's inventive act rested not in the substitution of his rearranged motor for another of prior art or in the combination of his engine with elements which had been combined with steam engines; but in the arrangement himself that "he devised and used such arrangements as Brayton had never conceived."

The real factor in this last decision which reverses the Selden patent is that the majority of present-day cars use the Otto engine type and not the Brayton type which Selden's patent covers. The trial court realized this and in its opinion stated "As a matter of fact, I believe that nearly all the cars made in the United States when these actions began were molded on French ideas; and used engines descended from Otto through Daimler and not from Brayton through Selden or any other American."

The anti-Selden counsel in its recent brief submitted to the Circuit Court of Appeals of the Second Circuit, New York State, and which court gave the final decision this week, says: "The Selden engine was old and well known. The small high-speed automobile engine was the result not of Selden's arrangement of a Brayton engine, but of Daimler's improvement upon the Otto engine."

Dugald Clerk, the eminent English authority on gasoline motors, submitted a vast amount of evidence dealing directly with the early history of gasoline engines and his evidence was largely responsible for the final decision in which the court declared that Selden followed the Brayton engine, whereas modern cars employ the Otto. In speaking on the situation, Mr. Clerk gave the following evidence: "I may say that Selden disclaims the invention of any special engine. Stopping at this point it is necessary to recognize what type of engine is indicated. About this I have no difficulty whatever. I at once recognize it (Selden's

engine) as an engine of the Brayton type, operating on the constant pressure cycle." Mr. Clerk's evidence further showed that the Brayton engine was well known previous to 1879 when Selden obtained his original patent. One of these engines had been exhibited at the Centennial Exhibition in Philadelphia, 1876. Selden not only saw it there, but sent a mechanic to study it. In his original patent applications Selden mentions his engine as old and well known; the patent office discovered in it nothing but a Brayton, and Selden admitted the correctness of its conclusion. Dugald Clerk not only admitted the correctness of such conclusion, but was surprised that it took the Washington patent office so long to reach it. He "at once" recognized the Selden engine as a Brayton. The trial court which decided in favor of Selden was of the opinion, however, that Selden's discovery was of "the lack, the something that had to be supplied before it was worth while to organize the vehicle," and that he (Selden) supplied "the lack" by an improved Brayton engine.

Clerk in June, 1909, on the matter of Selden's improved Brayton engine wrote: "Brayton constructed his engine in America * * * He applied the inverted vertical engine to a tram car, but did not succeed in running it commercially. The horizontal engine he applied to a boat. Two of the boats were in use upon the Hudson for some years. Brayton was enthusiastic and indefatigable and spent most of his life in his many experiments; ultimately he abandoned his American attempts and crossed over to England and died in Leeds while engaged with experiments on a new oil engine at large works there. His perseverance deserved a better reward. No one, however, has yet (1909) succeeded in carrying his type of engine further than he did. This was submitted by Panhard and Levassor and Andre Massenant as evidence in their final brief, December, 1910, which brief brought about the final definition of the patent in which it is held that the modern motor car is not an infringement of the original Selden patent."

In his testimony Dugald Clerk admitted that Selden did not in any way advance the motor car industry. No one ever attained commercial success with a Brayton engine; and that modern cars "were modeled on French ideas and used engines descended from Otto through Daimler and not descended from Brayton through Selden or any other American."

In speaking of the Otto two-cycle engine, which was the determining factor in the decision, Dugald Clerk stated: "In 1876 Dr. Otto superseded his former invention by the production of the Otto silent engine now known all over the globe. He began his work in 1854, attained his first success in 1866, and his epoch-making advance in 1876. He died at the age of 59 and other hands took up the development of his four-cycle engine. Daimler took up the work and originated his first small engine along the lines now used in all motor cars in 1833. It was a high-speed engine and used a light hydro-carbon fuel now known as gasoline. It used a surface carbureter and dispensed with the slide ignition, substituting an open tube. These Daimler engines ultimately developed into the modern gasoline engine which performs such an important part in the life of all the leading nations at the present time."

Some general information on the Brayton, Otto and other early patents is interesting. Brayton in 1872 obtained a patent for a gas engine. It had a working cylinder and a pump. In the pump gas from a main was compressed and stored in a reservoir whence it passed to the working cylinder, at the entrance of which was a constant torch which ignited the gas particle by particle so that it entered the cylinder in a state of flame. The reservoir of gas frequently exploded. Clerk in speaking about this engine said that "This accident became so troublesome that Mr. Brayton discontinued the use of gas and converted his engine into a petroleum one. The petroleum was pumped upon the grating into a groove filled with felt. The compressing pump then charged the reservoir with air alone. The air in passing through the grating carried with it the petroleum partly in vapor, partly in spray; the constant flame was fed by a small stream of air. The arrangements were in fact precisely similar to the gas engine, except in the addition of a small pump and the slight alterations in the valve arrangements. The difficulty of explosion into the reservoir was thus overcome, but a new difficulty arose—the cylinder accumulates soot with great rapidity and the piston requires far too frequent removal for cleaning." About 1873 Brayton installed one of his engines in a Providence street car. It had only four horse-power and later he substituted for it a 12-horsepower engine. The space of one passenger was occupied by the engine and its connections. The car was operated repeatedly with each of the engines.

There is much interesting history which has been resurrected in connection with the present litigation. Newcomen in 1705 "made the piston engine a practical success," and since his time there have been features common to all engines, such as a cylinder, valves, and the piston so connected to the crankshaft that the back and forward movement of the piston is converted into rotary movement of shaft. In 1784 the British patent was granted to James Watt, in which "My seventh new improvement is upon steam engines which are applied to give motion to wheeled carriages for removing persons or goods from place to place." According to Professor Carpenter, the Watt patent showed in combination steering mechanism engine a power shaft arranged to run faster than the driven wheels, a clutch and the body. In 1828 Pecquer obtained French patents on a practical steam wagon. In 1858 the Lough and Messenger patents, covering a vehicle with two cylinders, 3 1-2 bore and 5-inch stroke, were granted; after two years' constant running of 15 miles an hour on level roads it was pronounced a success. In 1865 British patents were granted to MacKenzie, in which the inventor stated: "The invention consists of various improved arrangements in connection with steam or other engines for driving omnibuses, carriages, fire and traction engines, etc." This vehicle incorporated a running gear, a two-cylinder engine, a propeller shaft to run faster than the wheels, an intermediate clutch or disconnecting device. There is no mention made in this of a hydro-carbon engine of the compression type.

In 1871 United States patents were granted to Tellier for an improved ammonia engine for road locomotion. The use of external combustion motors was suggested among others by Brothier in 1865 and Carre in 1867. The Brothier patent shows the engine to be of the compression type. The Carre motor operated by air expanded by the combustion of liquid hydrocarbons. This was not an internal-combustion engine, but an engine used in compression, but generating the supply of flame under pressure outside of the motor cylinder. It could not be called a hydro-carbon gas engine because the term gas engine involves internal combustion and Carre's was an external combustion one.

It was in 1860 or thereabouts that the real turn toward the modern engine took place. The Lenoir in 1860 was one of the earliest and Lenoir gets credit as being the inventor of the first gas engine ever actually introduced to public use. It was used for printing, pumping water, driving lathes, etc. The merits of his engine were considered in the leading scientific reviews of that time.

Lenoir built an experimental road carriage propelled by one of his engines which was proved to have repeatedly circled the factory in which it was manufactured, and on one occasion made a three-hour trip.

In 1867 United States letter patents were granted to Otto and Langel for an improvement in gas engines.

Selden's Early Efforts

In noting the work by way of improvement which Selden accomplished on the Brayton engine the brief filed by the Columbia Motor Car Company and Geo. B. Selden shows that the Brayton engines were each constructed with very heavy and bulky bed plates. Some of them were constructed with flywheels and a large heavy walking beam, one end of which was connected to a piston rod and the other to a rod attached to the crankshaft. Brayton obtained two American patents for these engines, the first issued in 1872 for what is known as the Brayton gas engine, the primary fuel for which was street gas or illuminating gas. It has since become technically known as a constantly pressure engine, having a constantly burning flame to ignite the mixture as it enters the combustion chamber.

The other Brayton patent was issued in 1874, being an improvement on the 1872 one, the improvement consisting in using a fibrous absorbent for absorbing a liquid hydro-carbon and giving off the vapor therefrom, and also in using a deflector plate to deflect the air as it is forced through a central passageway, and to cause the air to pass over the fibrous absorbent to pick up the gasoline. Each of these engines was of great weight and very bulky.

Otto obtained two patents on his engine, one a British patent May 17, 1876, and the other August 14, 1877. This engine, known as the Otto Silent, came into commercial use in 1878. The Otto Silent engine was a compression type of large and bulky form like the Brayton and unsuited for combination with a road vehicle in not leaving room to carry the passengers. The Otto patent describes three kinds of hydro-carbon engines. One is a two-cycle, non-compression engine; another is a two-cycle, compression engine, the mixture being compressed outside of the cylinders, and the third is a four-cycle compression engine. Neither Otto nor Brayton were the inventors of the two-cycle or four-cycle engine. Liquid hydro-carbon engines of these types having been invented many years previously. All of the hydro-carbon engines previous to 1879 were used only as stationary engines, excepting one or two of the Brayton. By way of comparison the Brayton engine weighed 1160 pounds and the Selden three-cylinder engines, with all of its parts, 370 pounds. The Brayton engines were arranged to run at 200 revolutions per minute, which was considered a fair speed.

The Selden Problem—The brief shows that as early as 1873 Selden made experiments to determine the tractive power required to pull a load of 1000 pounds over common roads. In 1873 he devoted considerable time to the question of whether or not the steam engine was practical for use on the common roads. In 1873 he decided the problem could not be solved with a steam engine and so directed his thoughts to various other kinds of engines as, for example, engines operated by ammonia gas or other volatile liquids. And also engines to be operated by bisulphite of carbon, others operated by nitrous oxid and also by kerosene. After these investigations he turned his thought to the liquid hydro-carbon engine of both the non-compression and compression type, and finally decided that the problem could be solved only by a liquid hydro-carbon engine of the compression type.

His investigations led to two conclusions: first to construct a light weight engine of small bulk relative to power, and second to construct an engine that would manufacture its own fuel from the most compact primary fuel while traveling on the road. He discovered that he could obtain four times as much power from a compression engine as from a non-compression type of the same size. The brief shows that he could find no engine according to the old art of building suitable for his purpose.

In building his engine Selden used the enclosed crank chamber, he being the first to do this with a compression type of motor. He made this crank chamber continuous with a working cylinder.

Brayton Engine

Specifications of Patent Granted April 2, 1872, and June 2, 1874

UNITED STATES PATENT OFFICE.

George B. Brayton, of Boston, Massachusetts.

IMPROVEMENT IN GAS-ENGINES.

Specifications forming part of Letters Patent No. 125, 166, dated April 2, 1872.

To all whom it may concern:

Be it known that I, GEORGE B. BRAYTON, of Boston, in the county of Suffolk and State of Massachusetts, have invented certain new and useful improvements in Gas-Engines; and I do hereby declare that the following specification, taken in connection with the drawing making a part thereof, is a full, clear, and exact description of the same.

Figure 1 is a side elevation. Fig. 2 is a vertical section on the line x x of Fig. 3. Fig. 3 is a horizontal section on the line y y of Figs. 2 and 4. Fig. 4 is a vertical section on the line z z of Figs. 2 and 3.

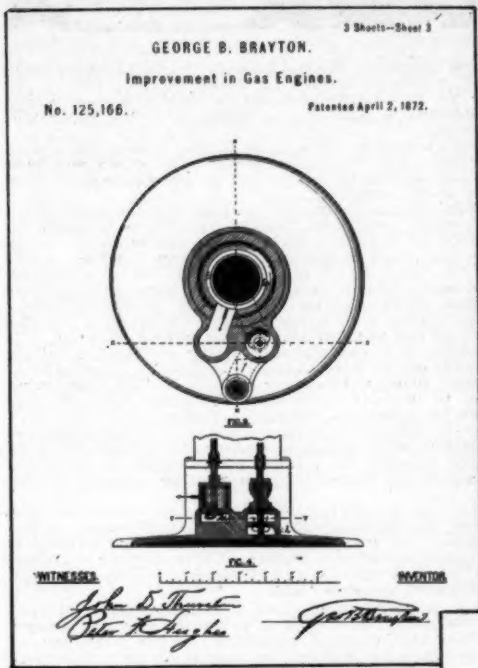
The drawing is made on a scale, with reference to the model, of six inches to the foot.

The invention hereinafter described relates to a means for making practically available, as a motive power, those compounds which result from the mixture of gases obtained from light hydrocarbons with atmospheric air. It has for a long time been known that such compounds were capable of developing, upon ignition, an immense degree of force, and various attempts have been made to employ them as motive agents for working machinery. My invention is embodied in a structure which provides, first, for maintaining an accumulation of a limited quantity of the gaseous compound under considerable but uniform pressure in the reservoir, the supply to the reservoir being always proportioned to the consumption of the engine, and the gaseous compound mixed only as it is introduced to the reservoir; and, secondly, for introducing a jet of the mixed compound so under pressure, while in the act of changing its volume as the result of ignition, into a cylinder, to act with its expansive force upon a moving piston.

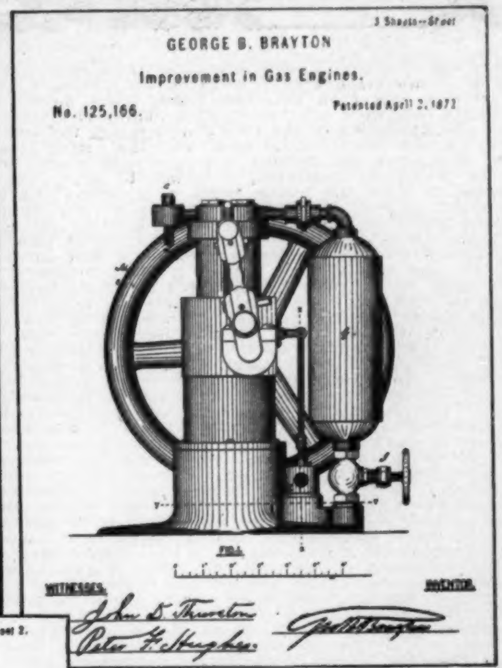
In the drawing I have represented a single-acting engine, arranged to exhibit my improvement. To construct a double-acting engine operated by this motive power would require changes of arrangement which any competent constructer would understand, but would not involve any change in principle.

Referring to Fig. 2, A is the cylinder proper of the engine, which is fitted with a piston, B. As the piston is exposed to the direct action of the ignited and heated gases it should be made of or protected by some material, as—for instance, soap-stone—capable of sustaining, without injury, a high degree of heat. The cylinder itself should also be incased with a water-tight jacket of metal, and enough larger in diameter than the cylinder to allow of a water-space between the two, through which water should be made to circulate. A convenient way for effecting this will be to connect a tank of water, which may be located at any convenient place, with the water-space by two pipes, one entering near the top and the other near the bottom of the same, as in the common arrangement for establishing a water circulation. The cylinder A is, in this instance, surmounted by an air-pump, the barrel of which is G. It is furnished with a piston, D, attached to the rod E, common to it and the piston B. This air-pump is supplied with a proper induction-valve, a, and eduction-valve, b, of any preferred construction and arrangement. F is a chamber, provided with two inlets, c and d. The former admits atmospheric air, and the latter, by means of any suitable tube or conducting-pipe, is connected with a supply of common illuminating-gas or other carbureted hydrogen—as, for instance, the volatile constituents of petroleum oils. The capacity of these two inlets may be regulated by means of a screw-valve applied to each, so that the relative quantities of air and gas to be admitted at the same time to the chamber F may be varied at pleasure. In general the proper proportions will be found to be twelve parts of air, by volume, to one of carbureted hydrogen to make a compound which, upon ignition, will be followed by a complete combustion; but, in practical operation, differences in chemical constituents of the gas employed will probably require variations in the required proportions of atmospheric air. It is obvious that the movement of the piston D of the air-pump will, at each downward stroke, draw into the barrel C a charge of gaseous compound through the valve a, and that upon the upward stroke of the piston the same charge will be forced through the eduction-valve b into the reservoir G. This reservoir should be constructed of strong boiler-plate, or of the best mixtures of iron used in casting ordnance. It should be made with reference to sustaining a constant internal pressure of at least sixty pounds to the square inch. It should be furnished with a pressure-gage, and with a safety-valve, arranged to open when the pressure from any cause exceeds the prescribed limit. It is not to be understood that any large volume of the gaseous compound is to be collected and retained within the reservoir G. Its interior capacity need not be more than twice the cubical contents of the cylinder A, but, nevertheless, of sufficient size to enable the air-pump (which should be properly proportioned to that end) to maintain within the reservoir a uniform maximum of pressure.

The arrangement of devices which I employ for applying the gaseous compound to work the engine is as follows: In a suitably-formed recess or chamber, H, formed at the bottom of the cylinder A, below the range of the down-stroke of the piston, I place any convenient number of wore-gauze diaphragms, e. These I call the "interceptors," because they serve to guard the passages through which the gas is supplied to the engine, and cut off the flame after the gas has been ignited from the supply which is flowing from the reservoir when the valve-connection is opened, and are so located that all gas consumed in working the engine must pass through them. I is a screw-valve, which, when opened, allows the gaseous compound to flow into the conducting-passage, f, with which and the recess or chamber H, spanned by the interceptors,



3 Sheets—Sheet 3
GEORGE B. BRAYTON.
Improvement in Gas Engines.
No. 125,166.
Patented April 2, 1872.
WITNESSES.
INVENTOR.



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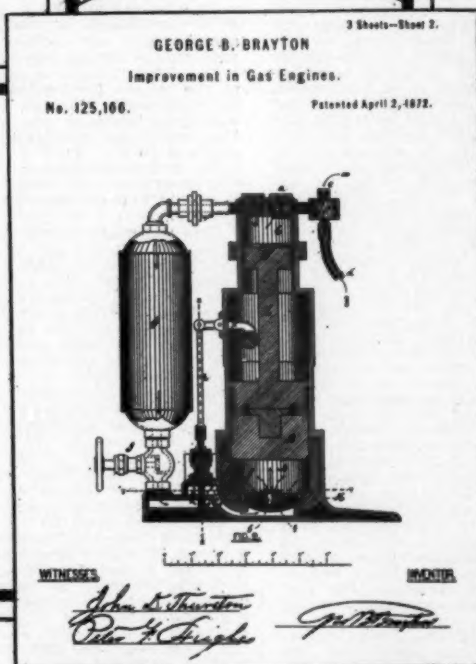
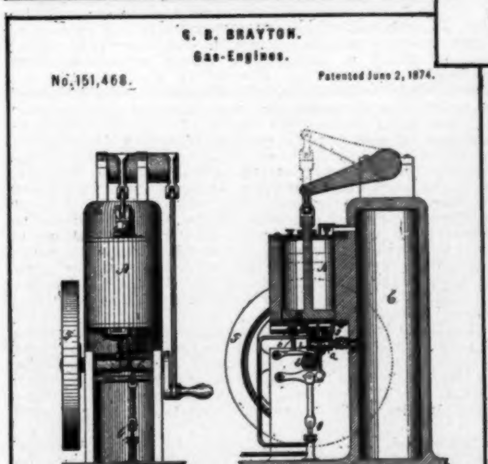
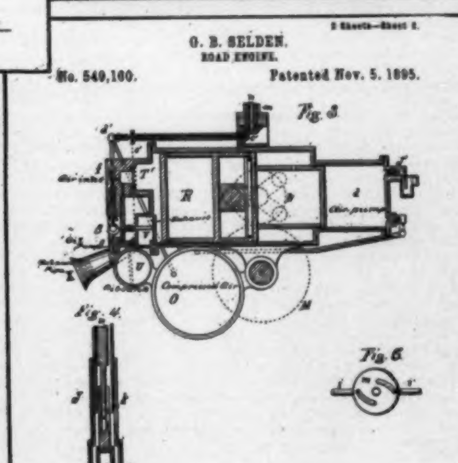


3 Sheets—Sheet 2.
GEORGE B. BRAYTON
Improvement in Gas Engines.
No. 125,166.
Patented April 2, 1872.
WITNESSES.
INVENTOR.



G. B. BRAYTON.
Gas-Engines.
No. 151,468.
Patented June 2, 1874.
WITNESSES.
INVENTOR.



G. B. SELDEN.
ROAD ENGINE.
No. 549,160.
Patented Nov. 5, 1895.
Fig. 3
Fig. 4.
Fig. 6
Inventor
Geo. B. Selden

a communication is made when the valve h is opened. The valve h is opened for every upstroke of the piston B by means of the revolving cam J on the main shaft, which causes the lever K to vibrate and work the valve-rod k, which is pivoted to such lever. The configuration of the cam J determines the length of time that the valve h shall remain open, and the spring j causes the valve to close upon the instant that the cam ceases to hold it open.

As previously indicated, I intend to apply the gaseous compound to work the piston while it is undergoing expansion after ignition. I have therefore to provide for maintaining a constant flame upon the upper surface of the interceptors, which will serve to fire each charge of gas so soon as it passes through the diaphragms of wire-gauze, and upon its first entrance to the cylinder. For this purpose I make a small V-shaped channel, m, in the edge of the valve h, or, which would be better, make a vent through the valve-seat and regulate its area by a check-valve. This allows a small quantity of the gas to flow at all times to the interceptors, which, being ignited, will burn tranquilly and with a lambant flame upon the upper surface of the interceptors, and constitute a living torch at the entrance of the cylinder to fire each charge of gaseous mixture in succession.

Let it now be supposed that the engine is to be put into operation. The reservoir G should be filled with gaseous compound to the desired pressure. This may be done by revolving the balance-wheel by hand if the engine be of small capacity, or a separate air-pump for charging the reservoir may be used in case the engine is too large to be readily revolved by hand. The screw-valve I is now opened, and a lighted taper is inserted through the exhaust-port L, Fig. 1. The small supply of gas admitted through the channel m in the valve h has struggled through the meshes of the gauze interceptors, and upon the taper being applied to it will burn quietly. The valve h is now opened by a starting-bar or other convenient means, and a charge of gas, under the pressure in the reservoir, rushes against the under side of the interceptors, and upon reaching the flame playing upon their upper surface is fired thereby. While in the state of expansion consequent upon ignition it exerts not a spasmodic or explosive force upon the piston, but a true pressure due to expansion on account of the fact that the piston is at the very commencement of its stroke when the expanding gas begins to act upon it, and the quantity of gaseous mixture during its period of admission is in proportion to the extent of the movement of the piston, and is put into the state of expansion upon passing the interceptors and entering the cylinder. The piston having completed its upward stroke, the momentum of the balance-wheel M, Fig. 1, which, by means of the common crank and links (shown at Fig. 1), is connected in any convenient way with the piston, which causes the piston to descend again, the injection-valve h being now closed. While the piston is descending a cam on the main shaft, acting upon a lever, Fig. 1, similar to that which works the valve h, opens the exhaust-valve M, Fig. 3, in a well-understood way. The exhaust-passage in the several figures is indicated by a broad black-feathered arrow. It would naturally be supposed that the flame caused by igniting explosive gas under pressure upon the surface of the wire-gauze interceptors would be forced back through the interceptors and ignite the gaseous compound in the passage f, connecting with the reservoir, and explode the contents of the latter. Many months of experiment with a working engine subjected to every variety of conditions likely to occur in daily use have proved to me that a series of wire-gauze diaphragms (six or more) perfectly intercept the flame and render danger from accident impossible; and that the flame has no tendency to turn backward is proved from the condition of the gauze after long use in showing no evidence of being even slightly burned. I have also repeatedly caused the gaseous compound in the reservoir to be fired, and the safety-valve in every instance has prevented the slightest injury to the apparatus. In case it is preferred to make use of any of the light hydrocarbons obtained from petroleum or other sources—as, for instance, naphtha—on account of the greater cheapness of the material over illuminating-gas, it will be found most convenient to allow the fluid having the necessary constituents to be dropped upon or absorbed by a sponge placed in a vessel, so that it can readily vaporize, and in that state be pumped off from the vessel by the air-pump, in combination with atmospheric air, into the reservoir for supplying the engine.

I have described the reservoir G as containing the mixed gases. It is, however, entirely practicable to employ two reservoirs, one of which shall contain the carbureted hydrogen and the other atmospheric air, the contents of both being condensed by pressure and mixed only as the charge from each reservoir enters the chamber H. Such arrangement would be more complicated in the machinery necessary to be used than the one described, requiring, as it would, induction-valves appropriate to each reservoir; but it would insure nearly absolute safety in the use of such gaseous agents of force.

I do not limit myself to the construction or arrangement of the several parts of the engine as described, inasmuch as the improvements which constitute my invention can be applied to engines of various forms.

What I claim as my invention, and desire to secure by Letters Patent, is—

The following apparatus or organisms in combination: a pumping-engine for condensing air and gas, a reservoir for containing such agents, either separated or when mixed, and a cylinder and working-piston, provided with suitable automatic valve-gear, operating induction and eduction valves, when such cylinder is furnished with a perforated partition whose office is to maintain a torch to fire the successive charges of gaseous mixture as they are entering the cylinder and prevent the back action of the ignited charge, substantially as described. GEORGE B. BRAYTON.

Witnesses: { JOHN D. THURSTON, PETER F. HUGHES.

UNITED STATES PATENT OFFICE.

GEORGE B. BRAYTON, OF BOSTON, MASSACHUSETTS.

IMPROVEMENT IN GAS-ENGINES.

Specification forming part of Letters Patent No. 151,468, dated June 2, 1874; application filed March 11, 1874.

To All Whom It May Concern:

Be it known that I, GEORGE B. BRAYTON, of Boston, in the county of Suffolk and State of Massachusetts, have invented certain new and useful Improvements in Gas-Engines; and I do hereby declare that the following specification, taken in connection with the drawings making a part of the same, is a full, clear and exact description thereof.

Figure 1 is a front elevation. Fig. 2 is partly a side view and partly a vertical section. Fig. 3 is a sectional view on an enlarged scale of the means for carbonizing the air in its passage to the combustion-chamber of the engine.

In the Letters Patent for improvement in gas-engines granted to me under date of April 2, 1872, No. 125,116, reference is made to the fact that the vapor of naphtha, mixed with atmospheric air in proper proportions, will form a gaseous compound, which upon being ignited, can be used as a motive power for the engine described in said patent. There exist, however, certain practical difficulties in the way of employing the vapors of light hydrocarbons with the apparatus shown and described in said patent, which it is the object of the present improvement to overcome.

My invention consists in a certain means for enabling a given quantum of atmospheric air as it is passing toward the combustion-chamber of the engine from a reservoir, where it has been confined under pressure, to become carbonized by being brought into contact with a liquid hydrocarbon, which is vaporized by the air-current passing over or through it, and such vapor being absorbed by the air a compound results which possesses the constituents of carbon, hydrogen and oxygen in proper proportions, to furnish, when ignited, the agent of force for the motive power of the engine.

The several charges for supplying the combustion-chamber are successively mixed at the instant of entering the engine under conditions which obviate the necessity of any reserve of explosive compound, and thus is removed the chance of any danger resulting from any collection of the same in a reservoir preparatory to being applied by ignition to develop force.

In the drawings, A is the cylinder of a single-acting engine. B is the piston of the same, and C is a reservoir for containing atmospheric air under any desired pressure, which pressure is maintained by an air-pump worked by the engine in any preferred way. The apparatus, in all other respects than those which relate to the means for vaporizing hydrocarbon liquids in small quantities for successive charges for the engine by the quantity of air itself, which is to form one of the constituents of the charge, may be the same as that described in the Letters Patent heretofore granted to me, April 2, 1872, and which may be referred to for the fuller understanding of the machinery employed.

D represents a pipe, furnished with a regulating-valve, which connects the air-reservoir C with the induction-passage a to the cylinder A.

E is the main shaft, upon one end of which is a suitable balance-wheel F. This shaft is furnished with suitable cams for opening alternately at the right times the injection-valve b and exhaust-valve c. It is quite evident that if air be contained in the reservoir C under pressure a charge will be admitted once in every revolution of the shaft E to the induction-passage a by reason of the opening of the injection-valve b by the cam on the shaft, which in this case is effected by the impinging of the surface of the cam upon the lever d, the stem of the valve b being linked to such lever.

In order to enable each charge of atmospheric air admitted into the induction-pipe leading to the combustion-chamber a to vaporize the proper equivalent of liquid hydrocarbon sufficient to form, when absorbed by it, a gaseous compound to be subsequently ignited, the end of the induction-pipe is, in this instance, surrounded by an annular space e, which is to be stuffed with sponge, felt or some fibrous absorbent, Figs. 2 and 3. This fibrous or cellular substance is charged at each revolution of the shaft with a prescribed quantity of liquid hydrocarbon, and this can be conveniently done by means of a suction and forcing pump G, the plunger of which is worked by a cam on the main shaft, as shown at Figs. 1 and 2. The vessel or reservoir containing the liquid hydrocarbon may be located at any safe and convenient point and connected with the barrel of the pump by the suction-pipe f. A regulating-valve is applied to the suction-pipe to determine the quantity of fluid that shall be injected at each charge. The top of the induction-pipe and the surrounding annular chamber is covered with a metallic disk or plate g, forming a valve, which is held down by a light spring h. When the charge of atmospheric air is admitted through the injection-valve b from the air-reservoir C it is resisted by the valve g sufficiently to cause the current, which spreads in all directions as it raises the valve, to come into contact with the top surface of the fibrous matter charged with liquid hydrocarbon in the annular chamber; or, if preferred, the sides of the inducted pipe may be perforated with holes, whereby the air, to the extent of the resistance of the spring-valve g, will be forced through the fibrous material in the annulus. The result is that the air-current vaporizes under these conditions in proportion to its volume and intensity so much of the hydrocarbon fluid as is required to make the well-known gaseous compound which a mixture of such constituents produces. This agent of force now passes through the perforated diaphragm H or flame-intercepter into the combustion-chamber, when it is fired in the manner described in my previous Letters Patent.

I have found in the use of the apparatus described that when the temperature of the atmosphere is too low to support a vapor the force of the charge of air from the air-reservoir will drive off the hydrocarbon fluid in the absorbent in the form of fine spray, which will be borne by the air-current into the meshes of the gauze flame interceptor H, where it instantly vaporizes and combines with the air.

Although I have described what I conceive to be the best form of apparatus for volatilizing hydrocarbon fluids, and causing the same to combine with the required equivalents of atmospheric air to form a gaseous mixture to be used as a motive power, I do not limit myself to the precise form of the devices or the arrangement described. Thus, instead of a fibrous absorbent, one or more disks of fine wire-gauze may be used, or any other suitable means, for enabling the fluid, when delivered in small quantities into the chamber, to spread itself out in a film or be disseminated over a considerable space, so as to be readily taken up in the form of

vapor or fine particles by the air-current passing over or through it; also the chamber e, if made of sufficient area, can be supplied with hydrocarbon liquid without employing special means, as described, for enabling it to spread over a large surface and very good results be obtained.

The essential features of my invention will be embodied in any apparatus which employs a reservoir, containing atmospheric air under pressure, and arranged to deliver a charge or air into an induction-pipe leading to the combustion-chamber of the engine, when such charge of air is made to travel in its course over or through a hydrocarbon fluid, so that the air-current can either vaporize and combine with the vapor of the fluid or take up and bear away the fluid in fine globules, to be subsequently vaporized on entering the combustion-chamber.

What I claim as my invention and desire to secure by Leters Patent is:

1. An apparatus for mixing atmospheric air and volatized hydrocarbons in successive charges as a motive power, when ignited, for a gas-engine, consisting of a reservoir C, containing atmospheric air under pressure, in combination with a hydrocarbon chamber and an automatically actuated valve, which is arranged to intermittently admit compressed air to pass from the reservoir in successive charges into the hydrocarbon-chamber, substantially as described

2. The air-reservoir C, for containing air under pressure, the hydrocarbon chamber e and an intermittent injector arranged to supply the chamber with hydrocarbon in successive charges, substantially as described. GEORGE BAILEY BRAYTON.

Witnesses: Wm. Burlingame, Jas. Clark.

Selden Engine

Text of Original Patent as Applied for in 1879, and Granted November 5, 1895

UNITED STATES PATENT OFFICE.

GEORGE B. SELDEN, OF ROCHESTER, NEW YORK.

ROAD-ENGINE.

Specification forming part of Letters Patent No. 549,160, dated November 5, 1895. Application filed May 8, 1879.

To all whom it may concern:

Be it known that I, GEORGE B. SELDEN, a citizen of the United States, residing at Rochester, in the county of Monroe, in the State of New York, have invented an Improved Road-Engine, of which the following is a specification, reference being had to the accompanying drawings.

The object of my invention is the production of a safe, simple and cheap road-locomotive light in weight, easy to control, and possessed of sufficient power to overcome any ordinary inclination.

The difficulties heretofore encountered in the application of steam to common roads are the great weight of the boiler, engine, water, and water-tanks, the complicated aparatus necessary to adapt the machine to the roughness of the roads which it must traverse, the necessity of the attendance of a skilled engineer to prevent accidents, and the unsightly appearance of the locomotives built on this plan. I have succeeded in overcoming these difficulties by the construction of a road-locomotive propelled by a liquid-hydrocarbon engine of the compression type, of a design which permits it to be operated in connection with the running-gear, so that the full carrying capacity of the body of the vehicle can be utilized for the transport of persons or goods, and which, by dispensing with skilled attendance and with steam-boilers, water, water-tanks, coal and coal-bunkers, very largely reduce the weight of the machine in proportion to the power produced and enables me, while employing the most condensed form of fuel, to produce a power road-wagon which differs but little in appearance from and is not materially heavier than the carriages in common use, is capable of being managed by persons of ordinary skill at a minimum of trouble and expense, and which possesses sufficient power to overcome any usual inclination.

My improved road-engine is represented in the accompanying drawings, in which—

Fig. 1 is a side elevation. Fig. 2 is a front elevation. Fig. 3 is a vertical section through my improved hydrocarbon-gas engine. Fig. 4 is a vertical section through the flexible valve connections. Fig. 5 represents the slotted plate for operating the clutch or clutches.

A A, Fig. 1, is the body of my improved road-locomotive, which may be of any ordinary or desired form, with any number of seats and with or without a top.

B B are the driving-wheels, which are of any usual construction, and C the trailing wheels.

D and E are respectively the springs of the two pairs of wheels.

F is the fifth-wheel, to which the springs D are connected.

G is the steering device, and H the hand-wheel for operating the same. Z is a brake, which is controlled by a cord running forward to the foot-lever T.

The liquid-hydrocarbon-gas engine L may be connected with either the steering or trailing wheels; but I prefer to drive the steering-wheels in vehicles of the type represented in the accompanying drawings. The most convenient way of arranging the cylinders of the liquid-hydrocarbon engine is transversely to the driving-shaft, as shown in the drawings. The gas-engine is provided with a powershaft carrying a pinion N, meshing into the gear M, fixed to the driving-axle. By attaching the cylinders, which may be of any convenient number, to the air-reservoir O, Figs. 2 and 3, which is a shell closed at each end and arranged parallel to the driving-shaft, a compact arrangement is obtained. If the driving-shaft passes through the air-reservoir, it should pass through a tube secured to the heads at each end in order to avoid stuffing-boxes. Journals for the driving-shaft may be formed on the heads of the air-reservoir, or where the shaft is located outside of the reservoir, as in Fig. 3, the gas-engine is connected with the shaft by suitable boxes. The springs D are attached at their lower sides to the air-reservoir or to a frame connecting the journals on the driving-shaft and the engine. In the construction shown in Figs. 1 and 2 a portion of the upper side of the air-reservoir is removed and the cylinders of the gas-engine are cast in one piece with a curved flange which is riveted over the top of the air-reservoir. On their upper sides the springs D are connected with a frame P, which is fastened to the worm-gear constituting the fifth-wheel F.

Any form of liquid-hydrocarbon engine of the compression type may be employed in my improved road-locomotive.

In the accompanying drawings I have represented an engine of the type in which air is compressed into a reservoir O by an air-pump J, Fig. 3, from which it is admitted to the working cylinder R by a valve f, operated by a cam-shaft S, along with a given quantity of a liquid hydrocarbon injected by pump g from the tank U into the combustion-chamber T', the products of combustion, after expansion, being exhausted through valve V, opened by the cam-shaft S.

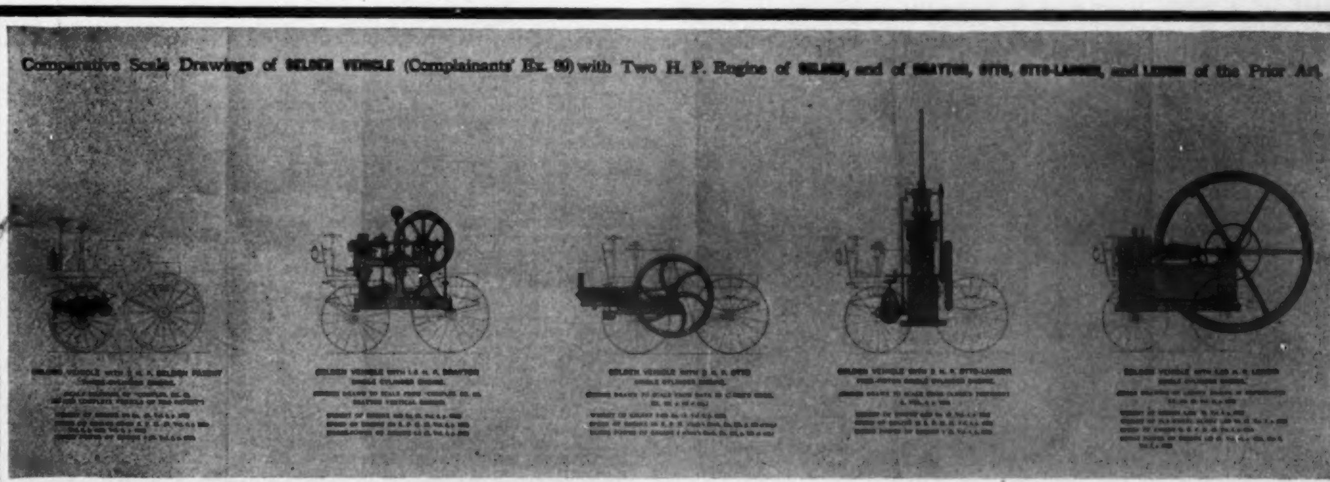
Fig. 3 is a central vertical section of the working cylinder and air-pump, and in which for convenience of illustration the combustion-chamber, air-valve, pump and exhaust-valve are represented in the same plane. It will be understood that in the three-cylindered engine shown each working cylinder is provided with suitable admission-valves and combustion apparatus and that the cranks are preferably arranged at equal angles with each other.

As the general construction and mode of operation of liquid-hydrocarbon engines of this class are now well known, it is considered unnecessary to further describe them here. The inlet-valve J' of the air-pump is provided with a dust-strainer composed of fine wire-gauze, cloth, or other material for preventing the entry of dust into the apparatus, and a bend in the entry-pipe may be filled with a liquid either with or without an absorbent material to further purify the entering air from floating particles.

X is the exhaust-pipe through which the products of combustion are discharged underneath the body.

The cam-shaft S is driven by the gear M on the axle of the driving-wheels. The gears should all be boxed in to exclude dust. A clutch Y, Fig. 2, may be interposed between the engine and the gearing M N to disconnect it from the same, in which case the cam-shaft S should be driven positively from the engine-shaft.

The traction-wheels B are attached to the axle by clutches j j', Fig. 2, splined on the driving-shaft and held in mesh by springs in order to permit of the wheels rotating independently of each other to facilitate progress over rough roads and the turning of corners. These clutches may also be used for the purpose of disconnecting the engine from the traction-wheels. This is accomplished by con-



necting the clutches with the rotating plate m by means of the rods i i', Fig. 2. The plate m is rotated from one of the hand-wheels I by the flexible connection J. An enlarged view of plate m is given in Fig. 5. It contains two spiral slots, into which the ends of the rods i i' project, so that when the plate is turned in one direction or the other the rods i i' will be drawn inward or thrust outward, thereby operating the traction-wheels. Friction or ball clutches may be used for this purpose.

In order to operate the clutches and the necessary valves of the engine, I employ flexible connections, as shown in Figs. 1 and 2, and enlarged in the section view, Fig. 4. The connections J between the hand-wheels I, placed conveniently under the control of the engine-driver, and the clutch or clutches and valve consist of tubes arranged one within the other, as many as may be necessary, and supported by suitable bearings on the body of the road-engine. The inner connection may be a road n, as shown in Fig. 4. Provision is made for the vertical oscillation of the body of the carriage with reference to the driving-axle by having each rod or tube composed of two parts capable of sliding on each other, but compelled to rotate together by a spline or pin k in the one fitted into a slot in the other. At their lower ends the connections pass into a suitable journal on the gas-engine. Above this journal each connection is provided with a universal joint p q, Fig. 4, which admits of the oscillation of the driving-shaft with reference to the body of the carriage, the sections of the universal couplings being long enough to admit of this motion in any direction. Each of the universal couplings is made enough larger than the one it incloses to allow of the rotation of the one without turning the other. The pins or lugs by which the couplings are connected together should fit in slotted holes to permit freedom of motion. Flexible shafts made of spiral wire coils in suitable coverings may be used instead of the universal connections herein described. The valves of the engine are connected with the lower ends of the flexible connections, so as to be operated therefrom in any convenient manner. The air-inlet valve d', Fig. 3, is controlled from the upper hand-wheel I by the innermost flexible connection, communicating at its lower end by gears c' with an extension-rod splined to the valve-stem. The inlet-supply valves between the tank U and the pump g are controlled by the flexible connections and the cord e', Fig. 3. The flexible connections are located in the center of the fifth-wheel F, so as to allow of the free action of the steering apparatus.

The fifth-wheel F is attached to the body of the carriage so as to be capable of turning thereon. In Figs. 1 and 2 it is represented as entirely boxed in by a dust-shield u. The fifth-wheel has a worm-gear cut on the periphery thereof, meshing with the worm S', Fig. 2, on a shaft which is attached to the body of the carriage by suitable boxes. The worm is rotated from the steering wheel H by means of the gear G and pinion t.

The wheels of my improved hydrocarbon road-engine may be provided with any suitable traction device for overcoming the resistance of rough or slippery roads or those of unusual inclination.

Provision is made for backing my improved road-engine by reversing the motion of the driving-wheels by a set of reversing-gears interposed between the pinion N and the gear M, the said gears being arranged to be brought into or thrown out of action by one of the flexible connections already described. A suitable arrangement of reversing-gears applicable to this purpose is found in the system of gearing used to reverse the motion of the feed-screw in engine-lathes; but I prefer to make the body of my road-engine with a crane-neck, so that the driving-wheel may be turned completely around underneath the driver's seat whenever it becomes necessary to propel the carriage backward.

The central space between the working cylinders and the air-pumps in which the cranks revolve (into which access is had through suitable hand-holes) may be used as a cooling-chamber by the introduction of a small quantity of water within it, either with or without an absorbent material, provision being made for the escape of any vapor by an outlet either directly into the atmosphere or into the exhaust-pipe from the engine.

It will be observed that my improved hydrocarbon-engine can be applied to a large proportion of the carriages in common use. It may also be applied in various other relations with the propelling mechanism different from those herein described or represented without interfering with or preventing the ordinary uses of a carriage-body. It may also be applied to carriages having perch connections between the axles of the two pairs of wheels.

In Fig. 1 I have represented a brake-shoe attached to the rear axle and arranged to be dropped into position between the wheel and the ground. It is operated by means of a chain of the proper length, attached to the body of the carriage and provided with a hand-wheel, spring-pawl and ratchet.

As it would be decidedly inconvenient to be under the necessity of extinguishing the flame in my improved traction-engine whenever it was required to make a short stop, the clutch Y (or the clutches j j') is interposed between the engine and the driving-wheels, so as to admit of the running of the engine while the carriage remains stationary.

I am aware that steam-carriages for use on common roads have been heretofore constructed on many different plans; but I am not aware that previous to the date of my invention any attempt was made to reduce the weight of a road-locomotive by the production of a compression liquid-hydrocarbon engine capable of locomotion, or that there was described or constructed a compression hydrocarbon-engine of such a design that it was capable of propelling a road-locomotive, more especially when the engine was so designed as to leave the body or platform of the carriage practically unobstructed for the conveyance of passengers or freight, except by the handles or wheels necessary for the guiding or controlling of the vehicle and the regulation of the engine.

I am also aware that it has been heretofore proposed to use liquid fuel in the furnaces of steam road-carriages for the purpose of generating steam for propelling the same—as shown, for instance, in English Patent No. 1,538 of 1863—and such arrangement, which does not remove any of the objections hereinbefore mentioned, I hereby especially disclaim.

I do not claim herein anything shown or described in the following English patents: No. 8,207 of 1839, No. 6,052 of 1830, No. 2,737 of 1871, No. 6,955 of 1835, and No. 780 of 1865.

I am also aware that it was suggested in English provisional specification No. 10 of 1878, that petroleum or other like motors "might be used to provide motive power" for tram-cars and other self-propelling vehicles.

I claim—

1. The combination with a road-locomotive, provided with suitable running gear including a propelling wheel and steering mechanism, of a liquid hydrocarbon gas-engine of the compression type, comprising one or more power cylinders, a suitable liquid-fuel receptacle, a power shaft connected with and arranged to run faster than the propelling wheel, an intermediate clutch or disconnecting device and a suitable carriage body adapted to the conveyance of persons or goods, substantially as described.

2. The combination with a road-locomotive, provided with suitable running gear including a propelling wheel and steering mechanism, of a liquid hydrocarbon gas-engine of the compression type, comprising one or more power cylinders, a suitable liquid-fuel receptacle, a power shaft connected with and arranged to run faster than the propelling wheel, an intermediate clutch or disconnecting device, and a suitable carriage body located above the engine, substantially as described.

3. The combination with a road-locomotive provided with suitable running gear including a propelling wheel and steering mechanism, of a liquid hydrocarbon gas-engine of the compression type comprising one or more power cylinders, a suitable liquid-fuel receptacle, a power shaft connected with and arranged to run faster than the propelling wheel, an intermediate clutch or disconnecting device, a suitable carriage body located above the engine and a flexible or jointed connection between the engine and the body, substantially as described.

4. The combination with a road-locomotive, provided with suitable steering mechanism, of a hydrocarbon engine applied to the driving axle and having flexible valve or clutch connections located within the steering mechanism, substantially as described.

5. The combination with a road-locomotive provided with a propelling wheel, of a liquid hydrocarbon gas-engine of the compression type, comprising two or more working cylinders and pistons arranged to act in succession during the rotation of the power shaft, a suitable liquid-fuel receptacle, suitable devices for transmitting motion from the power shaft to the driving axle, and a clutch or disconnecting device, substantially as described.

6. The combination with a road-locomotive, provided with a propelling wheel, of a liquid hydrocarbon gas-engine of the compression type, comprising one or more unjacketed working cylinders communicating with a closed crank chamber, adapted to hold a cooling liquid, and a power-shaft geared to run faster than the propelling wheel, substantially as described.

GEORGE B. SELDEN.

Witnesses:
CHARLES E. RIDER,
HENRY H. SCHLEBER.

The Decision

Text of Opinion Disregarding the Selden Patent, as Handed Down by the Court of Appeals

U. S. Circuit Court of Appeals.

SECOND CIRCUIT.

Before,

LACOMBE, WARD AND NOYES,
Circuit Judges.

THE COLUMBIA MOTOR CAR COMPANY
and
GEORGE B. SELDEN,
Complainants-Appellees,
vs.
C. A. DUERR & COMPANY
and
FORD MOTOR COMPANY,
Defendants-Appellants.

SAME COMPLAINANTS-APPELLEES,
vs.
THE O. J. GUDE COMPANY,
Defendants-Appellants.

SAME COMPLAINANTS-APPELLEES,
vs.
JOHN WANAMAKER, et al.,
Defendants-Appellants.

SAME COMPLAINANTS-APPELLEES,
vs.
SOCIÉTÉ ANONYME DES ANCIENS ETABLISSEMENTS,
PANHARD & LEVASSOR AND ANDRE MESSENAT,
Defendants-Appellants.

SAME COMPLAINANTS-APPELLEES,
vs.
HENRY and A. C. NEUBAUER,
Defendants-Appellants.

Appeals from decrees of the Circuit Court, Southern District of New York, sustaining the validity, and finding infringement, of

Letters Patent No. 549,160, granted November 5, 1895, to the complainant, George B. Selden, for an Improved Road-Engine. The corporation complainant is the exclusive licensee under the patent. The opinion of the Circuit Court is reported in 172 Fed., 923.

NOYES, Circuit Judge:

Although the title of the alleged invention as stated in the preamble of the patent is an "Improved Road-Engine," it is claimed to embrace the essential elements of the modern automobile and has been sustained as being "so fundamental and far-reaching as to cover every modern car driven in any way by petroleum vapor and as yet commercially successful."

The subject is most important; the interests involved of great magnitude; the record phenomenally long and the questions presented complex. In examining these questions we have been greatly aided by the work of the Judge of the Circuit Court in blazing the way through the mass of testimony and defining the issues to be decided. While we may be unable to adopt the conclusions stated in his very able opinion, we must at the outset acknowledge our indebtedness to it.

Ordinarily the first thing to be looked at in a patent suit is the patent. That is the source and measure of the patentee's rights. But in this case it seems desirable before we examine the patent to take up some preliminary considerations, the disposition of which may serve to indicate the standpoints from which the patent should be regarded in the examination to follow.

This patent was applied for in 1879 and granted in 1895. For over sixteen years the application lay in the Patent Office, and the applicant took full advantage of the periods of inactivity permitted by the rules and statutes. It is apparent that he delayed just as long as possible the issue of the patent to him. During this long time the automobile art made marked advances along different lines, and when in 1895 the patent was granted it disclosed nothing new. Others had then made the patentee's discovery and had reduced it to practice in ignorance of what he had done. While he withheld his patent the public learned from independent inventors all that it could teach. For the monopoly granted by his patent he had nothing to offer in return. The public gained absolutely nothing from his invention, whatever it was. From the point of view of public interest it were even better that the patent had never been granted. Judge HOUGH was quite within bounds in saying:

> "No litigation closely resembling these cases has been shown to the Court, and no instance is known to me of an idea being buried in the Patent Office while the world caught up to and passed it, and then embodied in a patent only useful for tribute."

It is urged that we should regard unfavorably the patent on account of this delay in the Patent Office; should seek to avoid giving it a broad construction, and should permit the alleged abuse of the law to weigh against the standing of the complainants in a court of equity. But the patentee acted wholly within his rights. He merely took advantage of the delays which the law permitted him. He followed strictly the statutes and rules of procedure, and the courts cannot exact a greater measure of diligence from him. When the patent was granted under the authority of the law it became entitled to the consideration accorded to any other patent. If the statutes and rules permit unnecessary delays they should be changed, but we reject the view that this Court owes any duty to relieve against their operation. This patent, even if it be useful only for tribute, must be viewed without prejudice and with absolute judicial impartiality.

But while we should be careful to avoid viewing the patent with disfavor, we should be equally careful to avoid considering it with too much favor on account of its subject-matter. Fifteen years ago hardly any one had seen an automobile. Ten years ago they were rare. To-day they are in use by tens of thousands, and tens of millions of dollars are invested in them and in their manufacture. The development of the automobile has been nothing short of phenomenal, and every one is inevitably impressed with its importance. Consequently, when we see that thirty years ago an application for a patent was filed which even pointed the way to the modern automobile, we can hardly fail to receive the impression that an idea of great importance must have been embodied in it. But, as we shall later see, the development of the automobile was not so sudden as we have thought. It developed step by step at the beginning; the startling activity has come at the end. Moreover, a great idea may be embodied in a patent, and yet the patentee take nothing of value by it. That which he takes is that which he describes and claims. His discovery may be of importance, but he may limit it by his claim, and his claim may proceed in the wrong direction.

So, from any standpoint, we come in this as in other patent causes to the patent in suit in which at its commencement the patentee thus states the object of his invention:

> "The object of my invention is the production of a safe, simple and cheap road-locomotive, light in weight, easy to control and possessed of sufficient power to overcome any ordinary inclination."

The patentee then states the difficulties encountered, his manner of overcoming them and the advantages arising therefrom:

> "The difficulties heretofore encountered in the application of steam to common roads are the great weight of the boiler, engine, water and water-tanks, the complicated apparatus necessary to adapt the machine to the roughness of the roads which it must traverse, the necessity of the attendance of a skilled engineer to prevent accidents, and the unsightly appearance of the locomotives built on this plan. I have succeeded in overcoming these difficulties by the construction of a road-locomotive propelled by a liquid-hydrocarbon engine of the compression type, of a design which permits it to be operated in connection with the running gear, so that the full carrying capacity of the body of the vehicle can be utilized for the transport of persons or goods, and which, by dispensing with skilled attendance and with steam-boilers, water, water-tanks, coal and coal-bunkers, very largely reduces the weight of the machine in proportion to the power produced, and enables me, while employing the most condensed form of fuel, to produce a power road-wagon which differs but little in appearance from and is not materially heavier than the carriages in common use, is capable of being managed by persons of ordinary skill at a minimum of trouble and expense, and which possesses sufficient power to overcome any usual inclination."

The patent then describes—as we shall later see with more particularity—the body, wheels and connections of the vehicle and the engine furnishing the motive power.

The first claim of the patent is the broadest, and the questions of validity and infringement have been presented wholly with respect to it. It is the vital claim in the case and is as follows:

> "The combination with a road-locomotive, provided with suitable running gear, including a propelling wheel and steering mechanism, of a liquid hydrocarbon gas-engine of the compression type, comprising one or more power cylinders, a suitable liquid-fuel receptacle, a power shaft connected with and arranged to run faster than the propelling wheel, and an intermediate clutch or disconnecting device and a suitable carriage body adapted to the conveyance of persons or goods, substantially as described."

The defenses are:

(1) That if the patent be broadly construed it is invalid;

(2) That if it be construed less broadly, but according to legitimate rules of construction, the defendants do not infringe.

In considering the validity of the patent, we are met, at the outset, with contentions of some of the defendants that prior uses anticipate and that that which it discloses is an aggregation rather than a combination. But the questions of novelty and invention often run together, and the inquiry whether a given association of elements is more than an aggregation is only a phase of the question of invention. We shall primarily test the question of the validity of the patent by the answer to the inquiry whether it discloses the exercise of the inventive faculties in view of the prior art.

This requires an examination of the state of the art in 1879—the date of the application, and, consequently, of the alleged invention.* In tracing its development we shall find that the combination described in the claim developed, to some extent, along with its elements. But this was by no means entirely so, and we think that a correct appreciation of the subject can best be obtained by considering:

(A) The development of the elements of the combination;

(B) The development of the combination itself—the motor vehicle.

The claim is for a combination possessing six elements:

(1) "A road locomotive provided with suitable running-gear, including a propelling wheel and steering mechanism";

(2) "A liquid hydrocarbon gas engine of the compression type, comprising one or more power cylinders";

(3) "A suitable liquid fluid receptacle";

(4) "A power shaft connected with and arranged to run faster than the propelling wheel";

(5) "An intermediate clutch or disconnecting device";

(6) "A suitable carriage body adapted to the conveyance of persons or goods."

Or, departing from the language of the claim, these are the elements:

(1) The **carriage** (including the running gear, the body, the propelling wheel and the steering mechanism);

(2) The **drive** (including the power shaft and connections and the intermediate clutch or disconnecting device);

(3) The **engine** (including the liquid fluid receptacle).

The claim contains no limitations with respect to the carriage element, and the specification states that the body of the road locomotive "may be of any ordinary or desired form, with any number of seats and with or without a top."

Reading the claim by itself any wheeled vehicle for the conveyance of persons or goods would come within its language, and the only limitation the specification could possibly impose upon it would be that the carriage should be of such a type that the engine could be located upon it without obstructing the body or platform.

So there are no limitations in the claim with respect to the running gear, propelling wheel or steering mechanism. While the specification and drawings show particular structures, there is no suggestion that the claim is confined to any particular form. Manifestly there was nothing novel in the carriage element.

With respect to the **drive** element: The claim describes no particular form of power shaft except that it shall be so connected and arranged as to run faster than the propelling wheel. Thus any speed reducing gear between the driving and the driven shaft would come within the language used. Gearing down to gain leverage under similar conditions was, however, old in the art. Mr. Dugald Clark—the distinguished and very competent witness for the complainants—says:

> "It was old in the art for a motive power engine to run at a greater speed than the propelling axle."

The claim likewise imposes no limitation upon the intermediate clutch or disconnecting device, and such devices were old in the art in 1879. They were commonly interposed between stationary engines and the load and had been employed in steam engines; the purpose being the same as here—to permit the engine to run without driving the vehicle. The drive element of the claim was old.

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*The date of the filing of the application—May 8, 1879—is prima facie the date of the alleged invention. The complainants, however, seek to overcome the presumption that that is the date and to carry it back to December, 1877. But while we have no doubt that the patentee conceived the general idea of the subject of the patent some time before he applid for it, there was no such reduction to practice or description of the whole structure as would serve to antedate the date of the application. It is true that the patentee made one of the elements of the combination—the engine—some months before he applied for the patent, but he did not make the combination itself—the road-locomotive—until many years afterwards, and that is what he claims a patent for. Moreover, we fail to find that any adequate description of the combination claimed was made any substantial time before the application. But while it is well to fix a starting point, the question between the dates is of little practical importance, as we find no prior use materially affecting the patent between 1877 and 1879.

The engine element in the claim is the one which requires the most extended consideration. It is the feature of the patent.

Th engine is described in the claim as "a liquid hydrocarbon gas engine of the compression type." Being an engine of this kind, it must, in the first place, be an **internal combustion engine**, which (using the definitions in the complainants' brief) is an engine in which "the fuel is burned in the engine cylinder and the heat energy thereof utilized by the expanding gases acting on the piston." In the second place, it must be a gas engine, which is "an internal combustion engine wherein the fuel is burned in a gaseous or vaporous condition." In the third place, it must be a **liquid hydrocarbon gas engine**, which is a gas engine "wherein the gaseous form of fuel is derived from a hydrocarbon liquid, such as petroleum, alcohol, etc." In the fourth place, it must be a gas engine of the **compression** type, which is "a gas engine using a compressed charge of gaseous fuel," and in which, consequently, the charge-containing space back of the piston will, at the time of ignition, "receive a larger amount of fuel in relation to its size than if the fuel was admitted thereto under mere atmospheric pressure.

Now gas engines were old at the time of the application for this patent and had been used for various purposes. We shall have occasion to examine their use for propelling vehicles when we come to trace the development of the motor carriage itself. So liquid hydrocarbon engines were in use, both of the compression and non-compression types. The phrase in the claim "a liquid hydrocarbon engine of the compression type" is descriptive of the Brayton engine, which came into use about 1873, and of the Otto compression engine, which came into use a little later, but still was in the antecedent art. The Brayton was undoubtedly the leading compression engine at the time of this application, but it was later superseded by the Otto.

These two engines—the Brayton and the Otto—play important parts in this case. We shall later have occasion to examine them at length and to compare them as belonging to two well-defined types of compression gas engines—the "constant pressure" type and the "contant volume" type. But it is unnecessary to describe them at this time or to define the terms which we have just employed. It is sufficient now to state the fact that the engine element of the claim—considered as an engine and not necessarily as a part of a combination—was in existence at the date of the alleged invention.

To recapitulate, we have examined the prior art and have found the different elements of the combination, other than the engine, admittedly old. We have also found the engine element old and represented by two types. We must now examine the art with reference to the combination itself and ascertain what, prior to 1879, had been the development of motor vehicles, particularly those for the carrying of passengers and goods.

For some years subsequent to 1830 steam carriages for common roads were used to a considerable extent in England for transporting goods and passengers. But the rapid development of the railroad locomotive, as well as the opposition to the use of steam vehicles upon highways, soon drove them out of use, so that for many years before the application for this patent steam engines had been used upon highways in this country and in England only for traction purposes.

Gas motor vehicles came later. As we have seen, gas engines were old in the art. The first suggestion of their use to propel road carriages was in 1860 in connection with the Lenoir engine. The Lenoir patent embraced the use of liquid hydrocarbon in the form of vapor, and the engine was successful for stationary purposes. It was a non-compression engine. An illustration published in Paris in 1860 showed a vehicle propelled by this engine, and it was described in various publications. If such a motor vehicle were operated it undoubtedly ran slowly, and the engine had great weight in proportion to power. But no reason is advanced why the Lenoir engine was not **capable** of propelling a vehicle.

The Mackenzie English patent of 1865, which the patent itself states was in the prior art, was for the use of steam or "compressed air or other motive power instead of steam" for driving an omnibus or carriage. The structure of this patent included the use of a geared down chain and clutch.

The Savalle French patent of 1867 described how the Lenoir engine could be applied to road vehicles. This patent referred to the difficulty of applying such engines to light carriages.

The Kirkwood English patent of 1874 was for an engine "worked by the explosive force of a mixture of gas and atmospheric air," and which, among other uses, might "be incorporated in the structure of an ordinary tramway car or other vehicle."

The Rosenwald French patent of 1877 was for a carriage propelled by a non-compression gas engine. This vehicle had reducing gears and a clutch or "disentangler." The engine described was of the free piston type and was poorly adapted for use in a road locomotive.

Other patents are shown in the prior art—to Menn, Wilson and others. But without examining them or further considering those which we have outlined, it is clear that if there were nothing more in the case invention would not be shown in the mere combination of (1) the carriage, (2) a drive and (3) a gas engine, or even a hydrocarbon gas engine. The elements were old and the combination neither novel as producing any new result nor as showing any new co-operative action.

It follows then that if we are to find invention and novelty in the broad combination of patent they must be in the use of a hydrocarbon gas engine **of the compression type.**

We have seen that hydrocarbon gas engines of the compression type were old in the art and were represented by the Brayton constant pressure engine and the Otto constant volume engine. The inquiry then is whether either of these engines was ever combined with the other elements for propulsion purposes before the application for this patent.

The testimony shows clearly that prior to 1878 Brayton had successfully applied his engine for propulsion purposes in boats. Several launches from twenty-five to thirty-five feet in length had been equipped with and operated by them. The evidence, including sketches, shows geared down transmission, the use of disconnecting clutches and the presence of liquid fuel receptacles. Indeed, if the claim be given the broad construction of covering the use of all compression gas engines, it might be read on the Brayton boat construction—if the words "motor boat" and "boat" were substituted for "road locomotive" and "carriage." Still, we appreciate the substantial difference between the problem of propelling a boat and the motor vehicle problem and are not inclined to hold that this use constituted an anticipation, although it may properly be considered in determining the question of invention.

It also appears that about 1874 Brayton used one of his engines to propel a street car upon a trial track near the city of Providence. The car was propelled back and forth over the half-mile track and up a slight grade. Some passengers were carried. There were reversing and disconnecting devices. The engine was large and heavy in proportion to the power which it furnished, and —an accident taking place—it was not long used. More power in proportion to weight was necessary for commercial street railway purposes, and the plan of installing these engines was given up— financial considerations entering into this determination. But although the experiments did not develop a commercial success, they were successful from a mechanical standpoint. The engine ran the car considerable distances and carried passengers. This use was not an abandoned experiment, but an abandoned attempt to induce the railway company to equip the cars with the Brayton engine. The perfected structure was capable of practical use, although there was much room for improvement. It was not embryotic or inchoate. The combination of the engine, the drive and the carriage was used in public, and therefore it required the use of the initiative, and not of the inventive, faculties to claim, without modification, the same combination. The use of the engine in one vehicle pointed directly to its use in another vehicle.

The Brayton engine was alone used upon an omnibus in 1878. The weight of the testimony is that the omnibus was run by the engine a very short distance, but the experiment cannot be regarded as having been either mechanically or commercially succesful. This use will not be considered as in the antecedent art.

In the state of the art thus disclosed the patentee filed his application for a patent. As we have seen, he claimed broadly the combination of a "liquid hydrocarbon gas engine of the compression type" with the other elements. It is true that in the specification and drawings he described and showed a particular type of engine, but he also said:

> "Any form of liquid-hydrocarbon engine of the compression type may be employed in my improved locomotive."

Taking the patent according to its terms, the case apparently presented is the ordinary one in which a patentee claims a broad invention and describes what he considers to be the best mode of applying it, but is not confined to that method. And if the prior art permitted such a patent in this case it might well be that it would be valid. But the prior art did not permit such a patent. Every element in the claim was old, and the combination itself was not new. Combinations of non-compression gas engines with the other elements had been in use, and Brayton had employed a "liquid hydrocarbon engine of the compression type" in a vehicle.

Even if the Brayton uses were not precisely anticipatory, we can reach no other conclusion than that with them in the prior art the claim in question must be held invalid for want of invention if it be given the broad construction the language apparently calls for. Moreover, if we give it a slightly narrower construction and treat it as covering the selection of the Brayton type of compression engine, the same conclusion must be reached. Invention would not be involved in the mere choice of that type of engine, for Brayton had previously made the same selection for his street car and boats. And even if the Brayton engine had been used only for stationary purposes, it is by no means certain that its mere selection for incorporation in a motor vehicle without adaptation would have involved invention.

In re Faure's Appeal, 52 Off. Gaz., 753 (Supreme Court, District of Columbia), is in point. In that case Faure claimed a patent for the combination of an electric motor with a vehicle. It appeared in that case, as in this, that boats had been propelled by the same kind of motor. The Court said (p. 756):

> "It is made evident that the mechanical arrangements for applying the power are not new, being familiar to all experts; and that the result is not new—viz., the movement of vehicles by electrical storage-batteries. It is admitted that Trouvé had propelled boats in this way. The contention that such a use did not anticipate this application because that experiment was on water and this invention is designed for use on land seems untenable. The propulsion of vessels through water by such batteries is within the same principle as locomotion on land."

In **Shaw Electric Co. v. Worthington**, 77 Fed., 992, 993, the patent was for an improvement in traveling cranes through the substitution of independent electric motors for the power previously furnished by steam power. Judge ATCHESON said:

> "The facts, then, being as above stated, what element of invention is to be found in the patent here in suit? In view of the previous employment of electric motors in propelling street cars, driving machinery in mills, working elevators, etc., the mere application of electric motors to traveling cranes certainly did not involve invention, even had Shaw been the first to operate cranes electrically. The inventive faculty was no more exercised here than in a multitude of other instances in every branch of industry where the electric motor has been substituted for the steam engine or other source of power."

Indeed, Mr. Clerk himself says:

> "I have already stated that if the Lenoir, Brayton, Otto and Langen and Otto silent motors were all supposed to be in active existence and running, doing stationary work, that the mere selection of one of these motors with alteration and the application of any one of them without alteration of any kind would not involve an act of invention."

It must be distinctly borne in mind that we are not now considering the alteration of any engine for the purposes stated in the patent; the question of the superiority of a combination embracing a modified or reorganized engine, or the invention involved in making it. We are, for the time being, taking the claim as it reads in connection with the broad statement in the specification, and we conclude that, taken in that way, invention is not disclosed. It should also be observed that this conclusion is not

inconsistent with a holding that the patent is valid upon its face. The antecedent art as shown by the testimony goes far beyond that disclosed by the patent or that of which the Court could take judicial notice.

But we are reluctant to so construe the claim that it must be held invalid for want of invention. We are of the opinion that the patentee had ideas ahead of the times and appreciated many aspects of the problem to be solved in creating a practical motor vehicle. Reading his statement of the difficulties encountered, his manner of meeting them, and the advantages of his discovery, we think it evident that he understood that an engine suitable for a light vehicle could not be taken bodily from the prior art and used without change, but that modification and adaptation were required. In our opinion, the statement in the patent that any form of compression engine may be employed is inconsistent with the intention disclosed by the patentee in the patent as a whole and should not have too much stress laid upon it. We also think that we should examine the specification, including the drawings and the model, to determine whether the patentee in addition to expressing the need of adapting an engine to the purposes of a motor vehicle shows that he actually adapted one. It may well be that the claim as limited by the specification should be held to be valid.

As already shown, the patentee states at the commencement of his patent that the object of his "invention is the production of (1) a safe, (2) simple and (3) cheap road locomotive, (4) light in weight, (5) easy to control and (6) possessed of sufficient power to overcome any ordinary inclination."

He then, as shown in the extract from the patent quoted at the beginning of this opinion, points out the difficulties involved in the use of steam engines upon common roads and states that he has overcome them by his road locomotive propelled by his liquid hydrocarbon engine of the compression type.

He next states that the advantages of his invention are:

(1) Dispensing with steam boilers, coal and water and the structures necessary to their use and employing a condensed form of fuel, thereby reducing the weight of the machine in proportion to the power produced;

(2) Producing a power road wagon light in weight; capable of being managed by persons of ordinary skill and having sufficient power for ordinary purposes.

The patentee also describes with reference to the drawings the body of the road locomotive, the driving wheels, the clutches, the gearing, the springs, the fifth wheel, the steering device, the brake and other parts of the structure and also indicates the preferable locations of various devices and preferable methods of connection.

The patentee describes with reference to the drawings the engine element, pointing out (1) the air reservoir, (2) the air pump, (3) the working cylinder, (4) the inlet valve, (5) the cam shaft, (6) the combustion chamber, and other details. He also briefly describes the operation of some of the different parts. The description, however, both of the construction and operation of the engine is quite incomplete. This was appreciated by the patentee, for he concluded his description by saying:

> "As the general construction and mode of operation of liquid hydrocarbon engines of this class are well known, it is considered unnecessary to further describe them here."

As the patentee thus refers to the existing art for a more complete description of his compression engine, and, as we have ascertained that there were two different types of compression engines in the art represented respectively by the Brayton and Otto engines, we must now find what those types were in order to determine which the patentee selected.

The two types are called respectively the **constant pressure** type and the **constant volume** type. Although these terms may have originated since the date of the invention, they correctly describe the types or classes of compression engines then in existence. No better explanation of them can be found than in Mr. Clerk's work, entitled "The Gas Engine," which was published in 1887 and which has been offered in evidence. In this book he also shows the construction and working processes of the two types of engines and the differences between them, as stated in the footnote.*

It is apparent from the descriptions in this work that a constant pressure engine is one in which the cylinder pressure remains the same during the outward travel of the piston, while the volume of flame increases. The pressure is applied continuously and not spasmodically. This mode of operation is also called "slow combustion" and "non-explosion."

A constant volume engine operates in a different manner from a constant pressure engine. The volume during ignition theoretically remains constant; the pressure increases. The action is spasmodic. The piston moves by explosive action and is kept in motion by a series of explosions.

The Brayton engine, to which we have referred, was a constant pressure compression engine. Mr. Clerk says in his book (p. 32) that it was one of the most successful of that kind and also said (p. 154):

> "The engine worked well and smoothly; the action of the flame in the cylinder could not be distinguished from that of steam; it was as much within control and produced diagrams quite similar to steam."

And in Prof. Thurston's contemporaneous report (1873) concerning the Brayton engine, quoted in Mr. Clerk's book (p. 157), it is said:

> "The operation of the engine is precisely similar in the action of the engine proper and in the distribution of pressure in its cylinder to that of the steam engine. The action of the impelling fluid is not explosive, as it is in every other form of gas engine of which I have knowledge."

The Otto engine, on the other hand, was a constant volume compression engine. Although the leading idea of compression and ignition at constant volume had been suggested before the time of this engine, Otto seems to have successfully applied it, and his engine came into general use. This engine was operated by a series of timed explosions and, as we shall later see, was the prototype of the modern automobile engine.

It is clear from this examination that the statement heretofore made that the Brayton and Otto engines differed in being respectively constant pressure and constant volume engines is sustained by the record.† They also differed in another important particular. The Brayton was a two-cycle engine. The Otto was a four-cycle engine. Turning to the complainants' definitions, we ascertain that "a cycle is a series of movements composing one complete operation," and that the following is a definition of the term **"two-cycle engine"**:

> "An engine whose operation is completed by **two** strokes—viz., a power stroke and a scavenging or exhaust stroke. If of the compression type, the power stroke simultaneously compresses the charge for the next power stroke, the charge thus compressed being admitted to the cylinder at the end of or during the scavenging or exhaust stroke."

The term **"four-cycle engine"** is thus defined:

> "An engine whose operation is completed in **four** strokes. Always of the compression type. First stroke sucks in the gaseous charge at atmospheric pressure; second stroke compresses the charge; third stroke is the power stroke; fourth is the scavenging or exhaust stroke."

The compression stroke in the two-cycle engine of the earlier art usually compressed the charge into an intermediate receiver, from which it was admitted in a compressed state to the cylinder. This was the construction of the Brayton engines, which were provided with outside mechanism, in which compression took place before the charge was let into the cylinder. The four-cycle engine, on the other hand, as represented by the Otto engine, had no such intermediate receiver. The single cylinder served alternately the purposes of motor and pump, and the charge was also compressed in it.

Now as the patentee in effect referred to an existing compression engine to supply the deficiencies in his description, and as the two existing types are represented by the Brayton and Otto engines, respectively, the question is, Which one did he refer to?

Comparing the engine drawings of the patent in suit with the Brayton patent drawings, we think it evident that the patentee adopted and, perhaps, adapted the Brayton apparatus. Looking at the written specification, it will be seen that an external air reservoir and pump are provided, showing that the engine was of the Brayton two-cycle type. Reading further, we observe that the patentee says:

> "As it would be decidedly inconvenient to be under the necessity of extinguishing the flame in my improved traction engine whenever it was required to make a short stop, the clutch Y (or the clutches j j') is interposed between the engine and the driving wheels, so as to admit of the running of the engine while the carriage remains stationary."

This constantly burning flame (or other continuous ignition) was necessary to the operation of the Brayton constant pressure engine. It was the "living torch at the entrance of the cylinder" referred to in the Brayton patent. Its existence was not essential to the timed explosion operation of the Otto engine.

So without any expert opinion, we should have no difficulty in determining that the engine of the patent is of the Brayton two-cycle constant pressure type. And the testimony even of the complainants' expert is to the same effect. Mr. Clerk said in his testimony that the reference in the patent to existing well-known engines was to the Brayton constant pressure engine.

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*In his book (p. 29) Mr. Clerk divides his gas engines according to their working processes into three well-defined types:

"1. Engines igniting at constant volume, but without previous compression;

"2. Engines igniting at constant pressure, with previous compression;

"3. Engines igniting at constant volume, with previous compression.

It is not necessary for the purposes of this case to examine the operation of the first type—the non-compression engine. With respect to the second type—the **constant pressure** compression engine, Mr. Clerk says (p. 31):

"In it the engine is provided with two cylinders of unequal capacity; the smaller serves as a pump for receiving the charge and compressing it; the larger is the motor cylinder, in which the charge is expanded during ignition and subsequent to it.

"The pump piston, in moving forward, takes in the charge at atmospheric pressure; in returning compresses it into an intermediate receiver, from which it passes into the motor cylinder in a compressed state. A contrivance similar to the wire gauze in the Davy lamp commands the passage between the receiver and the cylinder and permits the mixture to be ignited on the cylinder side as it flows in without the flame passing back into the receiver.

"The motor cylinder thus receives its working fluid in the state of flame at a pressure equal to, but never greater than, the pressure of compression. At the proper time the valve between the motor and the receiver is shut, and the piston expands the ignited gases till it reaches the end of its stroke, when the exhaust valve is opened, and the return expels the burned gases.

"The ignition here does not increase the pressure, but increases the volume. The pump, say, puts one volume or cubic foot into the receiver; the flame causes it to expand while entering the cylinder to two cubic feet. It does the work of two cubic feet in the motor cylinder, so that, though there is no increase of pressure, there is nevertheless an excess of power over that spent in compressing."

With respect to the **constant volume compression engine** Mr. Clerk says (p. 33):

"The compression cylinder may be supposed to take in the charge of gas and air at atmospheric temperature and pressure; compress it into a receiver from which the motor cylinder is supplied; the motor piston to take in its charge from the reservoir in a compressed state; and then communication to be cut off and the compressed charge ignited.

"Here ignition is supposed to occur at constant volume—that is, the whole volume of mixture is first introduced and then fired; the pressure therefore increases. The power is obtained by igniting while the volume remains stationary and the pressure increases.

"Under the pressure so produced the piston completes its stroke, and upon the return stroke the products of the combustion are expelled."

†We shall continue the examination of the differences between these engines when we consider the question of infringement.

He also said in his report to complainants' counsel, after referring to the description in the patent:

"Stopping at this point, it is necessary to recognize what type of engine is indicated. About this I have no difficulty whatever. I at once recognize it as an engine of the Brayton type operating on the constant pressure cycle. Although no description is given in the specifications, any one familiar with Brayton engines can see the air pump of smaller capacity than the motor cylinder, the air reservoir containing air compressed by the pump and the inlet valve admitting air to the cylinder. . . . Altogether I have no difficulty in seeing that the intention of the inventor is to operate by the constant pressure method, although he does not say so specifically."

It cannot, therefore, be questioned that the engine which the patentee referred to in the patent for the completion of his description was the Brayton engine. The Brayton mode of operation was adopted by reference as the Selden mode of operation, and this method, as we have already seen, was the constant pressure, two-cycle method.

The next question is, What modifications does the patent show that Selden made in the Brayton engine?

The Brayton patents and the testimony concerning the actual Brayton engines show that they were heavy and cumbersome in proportion to the power furnished. While such an engine did run a street car, it occupied considerable space, and a still larger and heavier engine would have been necessary to furnish sufficient power for the practical needs of the railway. The engines were poorly adapted for use in a vehicle upon common roads. When capable of furnishing sufficient power they were too heavy, and the reciprocating parts occupied too much space.

The written description of the patent, read in connection with the drawings, shows fairly that Selden made material improvements upon the Brayton structure in order to adapt it to the purposes of a road vehicle.

(1) The drawings show that the Selden engine has an enclosed crank chamber, it being a continuation of the working chamber. It is true that the only function of the enclosed crankcase mentioned in the written specification is that of a cooling chamber. But it is referred to, and it is clearly shown in the drawings, so that we think the patentee entitled to claim as a feature of his patent any benefits necessarily accruing from its use. We are also satisfied that the use of the enclosed crankcase rendered unnecessary the heavy bed plates of the formr Brayton construction and enabled the patentee to dispense with other heavy and cumbersome parts outside the casing of the cylinder.

(2) We also think it is the better view that Selden by his alterations increased the speed capabilities of the Brayton engine. Higher speed was obviously necessary for the purposes of a light road vehicle, and it was such a vehicle that it was the object of the patent to produce. The elimination of cumbersome working parts by the use of an enclosed crank case necessarily increased, to some extent, the capacity for speed. The plurality of cylinders referred to, but not required by, the specification and shown in the drawings produced, in the arrangement shown, continuous turning power and increased the speed possibilities over the old Brayton construction. The gearing ratio—the proportion of stroke to volume of cylinder—shown in the drawings, but not mentioned in the written specification, also gave increased speed.*

The improvements, then, which Selden made in the Brayton engine had these results:

(a) Decrease in weight in proportion to power produced;
(b) Decrease in bulk in proportion to power produced;
(c) Increase in speed.

To make these improvements we think that something more than mere mechanical skill was required, and, in view of the superior efficiency of the engine for the purpose for which it was designed, we hold that invention was involved. The complainants are probably right in saying in their brief:

"He (Selden) was compelled to materially reorganize the Brayton engines of the prior art, even to such an extent that a separate engine patent would have been fully justified by the degree of invention involved."

Selden did not, however, obtain a patent for his improvement upon the Brayton engine, but made the improved engine an element in his road locomotive combination. But no new co-ordinate action of the members of the combination is shown. The improved engine furnished the power, and the other elements co-operated with it in the same way that similar elements had co-operated with the older engines. The superior results would seem to have arisen from the superiority of the engine element alone. But it is not necessary to determine whether the associated action, as such, produced a new and useful result. It is sufficient to sustain the claim to hold that the combination embraced a novel element. The claim is held to be valid as covering a combination in a road locomotive of the different elements with a liquid hydrocarbon compression engine of the Brayton type; the limitation to this type being read into the claim by the specification to save it from invalidity.

It must be understood, however, that we do not sustain the claim upon the theory that Selden invented a light engine, an engine of small bulk or an engine of high speed, using those terms absolutely. We have made comparisons with, and have considered improvements upon, the Brayton engines only. Compared with them, we think the Selden engine lighter, less bulky and of higher speed. But we are not at all convinced that the Selden engine operating according to the Brayton or constant pressure method would be a high speed engine, as compared with one operating according to the explosive method. Constant pressure involving slow combustion seems consequently to involve slow operation.

The complainants urge that it places too narrow a construction upon the claim to limit it to a combination of which the engine element is an improved Brayton engine. They say that the improvements upon the Brayton engine which Selden shows in his patent merely illustrate the alterations and changes required by compression engines generally to fit them for the purposes of a light road vehicle. They say, in effect, that the engine element of the claim is any compression engine which has been adapted to vehicular purposes by changes similar to those made in the Brayton engine.

But we have been able to find that Selden reorganized the Brayton engine only by making close comparisons with that particular construction. We have nearly broken established rules by looking at the drawings by themselves to ascertain the changes made in that engine. There is little enough to be found about the improvements to it and nothing at all about the alterations of other engines. The patent does not pretend or attempt to lay down any rule for reorganizing compression engines to fit them for vehicular purposes. It does not say that other kinds of engines than the Brayton type require changes. It does not say that the changes made in the Brayton engine could be made in other engines, or that if made they would fit them for use in motor vehicles. No one could learn from the patent whether the Otto engine could be constructed with an enclosed crank chamber or whether the substitution of the gearing ratio shown in the drawing would increase or diminish its speed. With the patent before a person skilled in the art, experiments, certainly, and invention, not improbably, would have been necessary to determine the steps required to reorganize the Otto engine.

A patent is granted for solving a problem, not for stating one. Its description must explain the invention itself, the manner of making it and the mode of putting it in practice. In the absence of knowledge upon these points the invention is not available to the public without further experiments and further exercise of inventive skill. A claim for a combination which embraces an element only in case it is made capable of being employed in the combination and without disclosing means of adapting it discloses nothing definite. The questions remain: What engine is capable of being combined in a road vehicle? What changes are necessary to adapt it to the purpose? How are these changes to be made? If we were to construe the claim, as the complainants urge, we should be obliged to go further and hold it uncertain, indefinite and, consequently, invalid.†

For these reasons we must hold that the claim of the patent, limited by the specification in the manner shown, is valid unless, indeed, we are satisfied that the patented structure was inoperative and without utility. But, without discussion, it is sufficient to say that we have no doubt that an engine constructed according to the teachings of the patent, with its references to the Brayton engine, would, in combination with the other elements, run a road vehicle. We think that the patent discloses an operative structure, and that is sufficient. The defense of want of utility is not sustained. But any contention that a motor vehicle constructed by the patentee according to the teachings of the patent operated so successfully as to demonstrate that Selden had solved a great problem and is entitled to the status of a pioneer inventor is, we think, without foundation.‡

We come now to the question of infringement, and as it is conceded that the defendants use a combination embracing all the elements of the claim other than the engine element, and as it is also conceded that they use an engine of some kind in connection with such other elements, the question of infringement resolves itself into the inquiry whether their engine is a modified Brayton engine or its equivalent.§

But before we enter directly upon this inquiry we should briefly examine the development of the modern automobile and ascertain from what source the engines of the defendants' type were obtained, and especially whether they were borrowed from Brayton and Selden.

*The rule is, of course, appreciated that while the drawings of a patent serve to make plain doubtful or ambiguous statements in the written description, they cannot go further and supply the entire absence of the written description required by the statute. A strict application of this rule would probably prevent us from considering what the drawings show concerning the gearing ratio or the working of the cylinders—those subjects not being mentioned in the description. But in view of the stated objects of the patent and in view of the fact that changes in the Brayton structure referred to in the description tend to increase speed capabilities, we have thought that the rule should not be strictly applied in this case and that some weight should be given to what the drawings disclose in that direction, as supplementing the written description and not altogether as supplying its absence.

†Any force whatever in the complainants' contention must grow out of the presence in the patent of the statement to which attention has already been directed, that "any form" of compression engine may be employed. But just as we found that by giving those words their natural meaning the patent would be made so broad and sweeping as to be invalid in view of the antecedent art, so if we construe them as meaning "any adaptable engine" or "any engine which has been adapted" we make the patent indefinite and invalid. If the patent is to be sustained the language in question must be given a limited application. Under all the conditions we think that it should be construed as meaning merely that the patentee does not confine himself to any particular form or detail of the Brayton type of engine.

‡While the testimony with respect to the Selden vehicles constructed to illustrate the patent is sufficient to negative inoperativeness, it fails to show such practical success as to broaden the scope of the invention and certainly does not disclose invention in and of itself. We should be unable to sustain the patent upon any such theory as that advanced by the complainants' experts that Selden's invention consisted in producing "a successfully operative vehicle" or, "as a new result," "a practically unobstructed vehicle capable of great range of action." Of course, the vehicle had to be successfully operative in the sense of showing utility to make the patent valid, but that result did not show invention and novelty. Those essentials we were able to find only elsewhere. Moreover, the result of obtaining a practically unobstructed vehicle arose from the location of the engine upon the axle, which the defendants have not adopted, and that feature is not put forward in the complainants' briefs as being essential to the invention. And, furthermore, we are not at all convinced by the testimony concerning the vehicles in question—even assuming that their construction followed the teachings of the patent and nothing besides—that they showed capability for commercial use or possessed great range of action.

§A distinction is made by the Judge of the Circuit Court in con-

We have already noticed the motor vehicles of the art prior to 1879. Much had been attempted and little accomplished. Indeed, it was not until about ten years later, at the time of the Paris Exposition of 1889, that the real automobile art may be said to have begun. At that Exposition a Benz automobile was exhibited, and later the public interest was stirred by the Paris-Rouen race. In this country public attention was first called to the automobile by the Daimler exhibit at the Columbian Exhibition in Chicago in 1893, and in 1895 the Times-Herald automobile race took place in Chicago. The pioneer inventors appear to have been Daimler and Benz abroad, and Duryea, Olds and Ford (and perhaps one or two others) in this country.

These inventors selected for their automobiles the Otto compression engine. They did not select the Brayton engine, and, indeed, as Mr. Clerk says, the Brayton engine had practically disappeared from the market in 1889. Thus in their original type of engine they borrowed nothing from Brayton, and, of course, they could have actually borrowed nothing from Selden because his patent was not issued until 1895.

In some of the first automobiles the engine was located on the axle, as shown in the Selden patent. But this location below the springs caused too much jar to the machinery and was soon abandoned.

The Otto compression engine selected by these inventors has been modified and changed in its development into the modern automobile engine, and adjuncts of importance have been added. But none of these changes was, in fact, taught by the patent in suit, nor could many of them have been taught by it had it been issued. And the possible changes which it did indicate were suggestive merely.

The Otto compression engine did not at first employ electric ignition. A flame with a moving slide produced the timed explosions. Electric ignition was considered impracticable. But when the electric art had developed it was seen that the electric ignition could be made superior to flame ignition and would permit much higher speed. But the change was not indicated by the Selden patent, which refers only to flame ignition.

The inventors added a carbureter to the Otto engine, in which the charge of gasoline and air was mixed in exact proportions before it was conducted to the cylinder for compression. In the engine of the patent the air vaporizes the gasoline in the passage leading to the cylinder, and the proportions necessarily vary. The patent in no way pointed in the direction of the carbureter.

When the inventors began to adapt the Otto engine to the purposes of a road engine the desirability of lightness was apparent, and changes were made in the bed and castings so that the engine could be supported upon a steel frame instead of upon the heavy foundations used in stationary work. Other changes in the direction of decreasing weight and bulk and increasing speed were made. But these inventors were actually taught nothing in these matters by the Selden patent, and if it had been before them they would, as we have seen, have learned nothing definite from it.

We thus find that the defendants use an improved Otto engine, which retains the principle of that type and is, in its essentials, a four-cycle constant volume (or explosion) compression gas engine. Obviously it is not identical with Selden's improved Brayton engine, which is a two-cycle constant pressure (or slow combustion) compression gas engine; and so the final question is whether they are, under the patent, equivalents.

It is, of course, clear that an inventor is not limited to the particular structure illustrated in his patent as the best form known to him, provided his claim is broad enough to cover other or equivalent forms. If the claim in the present case could have been sustained as covering a combination of any hydrocarbon gas engine of the compression type with the other elements, the description in the specification of the modified Brayton engine would have been considered as a statement of the inventor's idea of the best form, but he would not have been confined to it, and the Otto improved engine would unquestionably have infringed. But we were unable to sustain the claim as so construed and could only hold it valid as being limited to a combination in which a Brayton modified or reorganized engine should be a member. The patent as so construed necessarily permits only a very limited range of equivalent forms. Being confined to an engine element of a particular class or type, an engine of another class seems almost barred by the interpretation itself. Still, classification might be based upon matters of form and not of substance. The elements of the combination are things and not names. In this as in other patents for combinations we think that the unity of the combination will not be affected by the substitution of elements which, however they may be classified or designated, perform the same function in substantially the same way, while it will be destroyed by the substitution of elements which do not perform the same office in substantially the same manner.

We must then consider the materiality of the differences between the engines in question. We have already seen that broad differences exist and must now determine their nature and extent. In giving weight to dissimilarities—in saying what are substantial and what relate merely to form—we must consider the degree of invention shown in the patent, although we will be unable to disregard differences as in the case of a patent of a primary character. And we think this means in the present case that the patent is entitled to a fair and reasonable, but not broad, range of equivalents. What is a fair and reasonable range can better be determined in the concrete comparison rather than in the abstract definition.

A close comparison of the engines shows many differences. Some are obviously mere differences in shapes and designs and may be at once disregarded. The following are those which appear to be the most material:

(1) The Selden engine has external compression mechanism, with a compressed air reservoir, while the defendants' engine has no such external mechanism, but compacts the charge in the working cylinder. Were the compression of the charge the only object to be accomplished, undoubtedly the gas and air could as well be compressed to the requisite degree before entering the cylinder as by compression in the cylinder itself. And even if internal compression gave superior results, it is probable that the one method would be the equivalent of the other. But if and in so far as outside compression is essential to a constant pressure engine, inside compression cannot be regarded as its equivalent unless we determine that the distinction between constant pressure and constant volume engines should be disregarded.

(2) The Selden is a two-cycle engine. The defendants' engines are four cycle. The Selden engine compresses into an outside chamber simultaneously with its power stroke, and with the next stroke drives out the burnt gases. Every second stroke is a power stroke. The defendants' engine draws in the charge with the first stroke and compresses with the second. The third stroke is the power stroke, and the fourth sweeps out the burnt gases. Every fourth stroke is a power stroke. But the first two strokes of the defendants' engine are merely pumping and compression strokes, and were the question here between a two-cycle explosion engine and a four-cycle explosion engine we should have little difficulty in finding the one the equivalent of the other.

(3) The Selden engine burns the charge as mixed at the entrance to the cylinder, while the defendants' engine compresses and mixes the charge inside the cylinder. The result in the latter case is that by the compaction in the cylinder after admission the mixture is brought into a homogeneous state, while in the former case the gas and the air burn at the inlet to the cylinder in a more or less non-homogeneous state, with the pressure behind them. The materiality of this difference in operation, however, lies in the fact that the one form is that of the constant volume engine; the other of the constant pressure engine.

(4) The Selden engine has no distinctive external vaporizing device, while, as we have seen, the defendants' engine is equipped with a carbureter, which determines the proportions of the mixture to be admitted to the cylinder and also increases its homogeneity. But by the construction shown in the patent the air vaporizes the hydrocarbon in the passage leading to the cylinder, and we think the carbureter, while undoubtedly an adjunct of great importance and advantage, should be held not beyond the range of equivalents.

(5) The Selden engine has constant flame ignition, while the defendants' engine has timed electric ignition. Probably continuous electric ignition would be the equivalent of constant flame ignition, but whether intermittent or timed ignition, which is an essential feature of the constant volume engine, is the equivalent of continuous ignition depends altogether upon whether the constant volume engine is the equivalent of the constant pressure engine.

So, lastly, we reach the question: Is the constant volume engine the equivalent of the constant pressure engine, under a patent, entitled to a fair and reasonable, but not broad, range of equivalents?

This is not a question of differences in terminologies or theories. It is a question of differences in principles and things. It is wholly immaterial whether the terms "constant pressure" and "constant volume" were in use when the patent was first applied for, or when or by whom they were first employed. It is equally immaterial whether we use those terms at all. We might just as well use the term "explosion" and "non-combustion" to designate the two types and, indeed, have repeatedly used them in this opinion. But the terms "constant pressure" and "constant volume" are convenient phrases which in themselves indicate methods of operation, and they are used in Mr. Clerk's book, to which we have referred and shall refer. So, although laying no stress whatever upon the mere names, we shall continue to use them.

It is also immaterial that by omitting the by-pass which furnishes a constant supply of gas; by changing the timing of valves and by using timed ignition, a constant pressure engine might be converted into a constant volume engine. The required alterations are by no means trivial, and the actuality of differences in principles and methods is not changed by the readiness by which they may be eliminated.

There is another matter which is also without importance. It is immaterial that a constant volume engine, under extraordinary conditions and with unusual adjustments, may be made to approximate the action of a constant pressure engine, or that a constant pressure engine under like conditions and adjustments may be made to approximate the action of a constant volume engine. The question is whether in their regular methods of operation the two types of engine are so similar as to be substantial equivalents.

Turning again—with the risk of repetition—to Mr. Clerk's book, we find that, in addition to his classification of compression engines, as shown in the extract already quoted, he says, in speaking of the constant pressure type (p. 152):

"In engines of this kind compression is used previous to ignition, but the ignition is so arranged that the pressure in the motor cylinder does not become greater than that in the compressing pump. The power is generated by increasing volume

sidering the question of infringement, which we think is not well founded. He says in his opinion:

> "Defendants seem continually to assume (without saying so) that Selden invented nothing more than a modified Brayton engine and then assert that they do not infringe because they do not use that particular motor and do use a modified Otto. They admit that the claim is for a combination, but continually seek refuge in defenses that would be good against any patent on Selden's engine, but are worthless against the combination if it be patentable at all."

Undoubtedly a patent upon a combination may be broader than a patent upon any or all of its elements. The members may co-operate to produce a new and beneficial result or operate according to a novel method. But it is not clear that any novel co-operative action is shown in the present case, and whatever new and beneficial result was produced by the combination seems clearly to have arisen from the superiority of the engine element alone. It has seemed well settled in the case that that which the patentee invented and used in his combination was a **modified** Brayton engine. There would have been no invention in combining an **unmodified** Brayton engine with the other elements.

But all this is beside the question of infringement. Even if it be conceded that the combination patent has a different scope than a patent for an improved Brayton engine would have had, it is none the less true that if the defendants do not use the modified Brayton engine and do use the modified Otto engine they escape infringement unless the latter is an equivalent of the former. It is well settled that to establish the infringement of a combination the use of every element of the combination must be shown.

at a constant pressure. Engines of type II (constaut pressure engines) are therefore:

"Engines using a mixture of inflammable gas and air compressed before ignition and ignited in such a manner that the pressure does not increase, the power being generated by increasing volume.

"These engines are truly slow combustion engines; in them there is no explosion.

"The most successful engine of the kind is an American invention; although proposed in 1860 by the late Sir William Siemens, it was never put into practicable workable shape till 1873, when the American, Brayton, of Philadelphia, produced his well-known machine."

And of his type III, or constant volume type, Mr. Clerk further says (p. 165):

"Engines of this kind resemble those just discussed in the use of compression previous to ignition, but differ from them in igniting at constant volume instead of constant pressure—that is, the whole volume of mixture used for one stroke is ignited in a mass instead of in successive portions.

"The whole body of mixture to be used is introduced before any portion of it is ignited; in the previous type (constant pressure type) the mixture is ignited as it enters the cylinder, no mixture being allowed to enter except as flame. In type III the ignition occurs while the volume is constant; the pressure therefore rises; it is an explosion engine, in fact, like the first type (non-compression), but with a more intense explosion, due to the use of mixture at a pressure exceeding atmosphere.

"In the third type are included all engines having the following characteristics, however widely the mechanical cycle may vary:

"Engines using a gaseous explosive mixture, compressed before ignition and ignited in a body, so that the pressure increases while the volume remains constant. The power is obtained by expansion after the increase of pressure."

Mr. Clerk considered these differences between constant pressure and constant volume so important that he made them **the basis of classification** in his book, and, notwithstanding his present testimony, we must regard them as substantial.*

It is true, as stated in the opinion of the Judge at circuit, that in all internal combustion engines the result of expanding in any way the gaseous fuel is the driving of the piston, but the method of operation is not the same when it is driven by explosive action as when it is driven by slow expansion. So in all compression gas engines the charge is compressed before ignition, but the compression of the whole charge and its instantaneous firing at the moment of greatest compaction is a very different thing from the ignition of successive compressed portions—particle after particle—as they enter the cylinder. In the latter case the force upon the piston is progressive—"the action of the flame in the cylinder could not be distinguished from that of steam" (Mr. Clerk's book, p. 154)—while in the former the force is spasmodic and explosive. These are differences in **principles and methods of operation**. And these differences in principles and methods are substantial. We are satisfied that the slow combustion method necessarily involves slow operation; not only because of the time required for combustion between strokes, but on account of the comparatively non-homogeneous character of the mixture. We are also satisfied that it gives less power in proportion to the size of the engine than the explosion method.†

It is our opinion, for these reasons, that in this road locomotive combination, embracing as its engine element an engine of the constant pressure type, the substitution in place of such engine of an engine of the constant volume type destroys the unity of the combination, because the two engines do not perform the same functions in substantially the same way. Granting the patent as broad a range of equivalents as its interpretation will permit and giving due consideration to the degree of invention involved, still we are not able to hold that the Otto improved engine is the equivalent of the Selden engine or that the defendants infringe by employing it as an element of their motor vehicle combination.

Let us briefly notice the consequences of an opposite conclusion. The Otto engine was in the prior art. Assuming that it was not adapted for propulsion purposes in a light vehicle, it would seem clear that the first person who showed invention in reorganizing and adapting it would have been entitled to a patent for the improvement and, with Otto's permission, could have used the improved engine in a vehicle. Similarly it would seem that he might have obtained a patent for a combination embracing the improved Otto engine as an element. But these things could not have been done if infringement is shown in this case. Selden, although selecting the Brayton engine, which was designed to avoid the explosive type, yet pre-empted the field and prevented all improvements for propulsion purposes in that type.

While the conclusion of non-infringement which we have reached leaves the patentee empty handed with respect to his patent for the short time it has to run, it cannot be regarded as depriving him through any technicality of the just reward for his labors. He undoubtedly appreciated the possibilities of the motor vehicle at a time when his ideas were regarded as chimerical. Had he been able to see far enough he might have taken out a patent as far reaching as the Circuit Court held this one was. But, like many another inventor, while he had a conception of the object to be accomplished, he went in the wrong direction. The Brayton engine was the leading engine at the time, and his attention was naturally drawn to its supposed advantages. He chose that type. In the light of events we can see that had he appreciated the superiority of the Otto engine and adapted that type for his combination his patent would cover the modern automobile. He did not do so. He made the wrong choice, and we cannot, by placing any forced construction upon the patent or by straining the doctrine of equivalents, make another choice for him at the expense of these defendants, who neither legally nor morally owe him anything.

The decrees of the Circuit Court are reversed, with costs, and the causes remanded, with instructions to dismiss the bills, with costs.

*Mr. Clerk uses the word "type" in his book in the sense of "kind" or "class." Thus he points out several different varieties of the different classes of engines. As we have quoted freely from the book, we have, to avoid confusion, used the same word in the same sense.

†Explosive action was the very thing which Brayton, who invented the engine which Selden modified, desired to **avoid**. In his foundation patent of 1872, in speaking of the long slow-burning operation of the combustible, he says:

"While in the state of expansion consequent upon ignition it (the flame) exerts, not a spasmodic or explosive force upon the piston at the very commencement of its stroke when the expanding gas begins to act upon it, and the quantity of gaseous mixture during its period of admission is in proportion to the extent of the movement of the piston and is put into the state of expansion upon passing the interceptors."

The statement concerning Brayton in "Engineering" for February, 1877, seems well founded:

"He turned his attention to the design of an engine in which an explosive mixture could be gradually consumed without the ordinary explosive action."

Columbia and Selden May Carry Case Up

Upon the announcement of the reversal of Judge Hough's decision, the A. L. A. M. authorized the publication of the following:

"As the courts have disagreed on the merits of the Selden patent on gasoline automobiles, it was announced yesterday that The Columbia Motor Car Company and George B. Selden are arranging to apply for a writ of certiorari with a view of having the case go to the United States Supreme Court for final decision.

"Judge Hough sustained the patent and held it infringed in the United States Circuit Court for the Southern District of New York, on September 15, 1909, but yesterday the decision of the Court of Appeals was filed, which, while holding the patent valid, decided that the defendants in the case, the Ford Motor Company, Panhard and Levassor, and others, had not infringed. The opinion was handed down by Judges Lacombe, Ward and Noyes.

"The litigation has been long drawn out, having been started in 1903. The patent was recognized by probably more than half the industry prior to Judge Hough's opinion in September, 1909, and following his sustaining of the patent as covering the modern gasoline automobile, a large number of other manufacturers secured licenses under it, until now it is estimated that almost 80 per cent. of the gasoline motor cars, including almost all of the veteran manufacturers, have taken licenses under the patent.

"The argument on the appeal was made in the latter part of November. The opinion, filed yesterday, written by Judge Noyes and concurred in by Judges Lacombe and Ward, covers forty-five typewritten pages, and, although sustaining the validity of the patent, declares that the defendants' automobiles in the case do not infringe."

Ford Had Little to Say

Henry Ford, president of the Ford Motor Car Company, who is in New York to attend the meeting of the S. A. E., had only the briefest comment to make on the result of the litigation. In speaking of it, Mr. Ford said:

"The facts in the case are before the public. The case has been in the courts for a long time. I do not wish to make any statement with regard to the outcome, preferring to let the public form its own conclusions."

Livingston Gifford, who was actively engaged in the recent presentation of the Ford Motor Car Company's side of the case before the United States Circuit Court of Appeals, received the following telegram from the Ford Motor Car Company the morning after the rendition of the decision:

"Accept heartiest congratulations on a well-won fight."

Mr. Gifford also received another congratulatory message from Attorney Walters, of Detroit, who is counsel for the independent companies in litigation with the A. L. A. M.